THE AMERICAN GAS LIGHT JOURNAL

ROMAN & KENNY, N.Y.

PUBLISHING OFFICE No. 42 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, HEATING, MECHANICAL, CHEMICAL AND GENERAL SCIENCE.

VOLUME LXXXVI., No. 11. Whole No. 1,658. | NEW YORK, MONDAY, MARCH 18, 1907. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. | THOMAS J. CUNNINGHAM, ELBERT P. CALLENDER, Editors.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

Published on each Monday of the year, at No. 42 Pine Street, New York.

Telephone.—2996 John.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $5 (£1—25 francs).

Remittances should be made either by post office order, express money order, registered letter, or bank draft on New York, payable to the order of A.M. Callender & Co.

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CONTENTS.

An Asterisk (*) denotes an illustrated article.

EDITORIALS—

Briefly Told 441

The Meeting of the Illinois Gas Association—Death of Mr. N. C. Dye—Current Comment.

Thirty-seventh Annual Meeting, New England Association of Gas Engineers—Report of Proceedings 442

First Day, Morning Session—Minutes of Last Meeting—Report of Directors—Election of New Members—Committee on President's Address—Report of the Secretary—Report of the Treasurer—The Reading of Correspondence—A Discussion on Tar as Fuel—Appointing Special Committee on Obituary Resolutions—The Present and Growing Need for the General Adoption of a Uniform System of Records and Accounts, by Dr. A. C. Humphreys—Concluded from Page 402.

*Report of Committee on Standard Methods of Testing Fuel Gas Appliances, Submitted to the American Gas Institute, Chicago, October, 1906, on Behalf Ohio Gas Light Association—Concluded from Page 405 447

Light and Illumination—No. I.—By Dr. C. P. Steinmetz. 450

Electrolysis of Gas Mains, by Mr. M. R. Bump 452

ITEMS OF INTEREST FROM VARIOUS LOCALITIES 454

Gas Lighted Buoys for Belle Isle—Change of Office—A Communication Anent Public Councils, Philadelphia—Self Propelled Vehicles—Annual Meeting, Providence, R. I.—Personal—A Generous Act—Must Put up a Deposit—The Projected Gas Plant for Merrill, Wis.—Personal—Injunction Made Permanent—A Show Room for Savannah, Ga.—A Stockton (Cal.) Ordinance—Gas for La Crescent, Minn—Public Lighting Rates, San Francisco, Cal.—Annual Meeting, Macon, Ga.—Ditto, Paterson, N. J.—Personal—And Other Items.

The Market for Gas Securities 456

BRIEFLY TOLD.

THE MEETING OF THE ILLINOIS GAS ASSOCIATION.—Through the courtesy of its Secretary, Mr. J. M. Robb, we are enabled to say, from the nature of the contents of the circular before us, that the Peoria meeting of the Illinois Gas Association, to be held in Peoria, Wednesday and Thursday of this week, will be well worth attending. The sessions will be called to order by the President, Mr. J. H. Eustace, in the assembly room of the National Hotel, at 10 A.M. of Wednesday. The Hon. A. B. Tolson, Mayor of Peoria, will welcome the Association, and the regular routine business will be followed by the paper on "Coal Fuel for Firing Gas Benches," by Mr. W. R. Rhoades, of Springfield. In the afternoon the paper, by Mr. A. D. Mackie, of Springfield-Peoria, on "New Business Methods," will be threshed out, and a general discussion on "What Can be Done to Boost the Gas Business in Illinois" will carry the session to adjournment. At 7 P.M. the Association will partake of a complimentary dinner, covers for which will be placed in the dining room of the Creve Cœur Club. The business sessions of the last day will include the reading of and debate on the paper, by Mr. W. I. Battin, of Chicago, entitled "Best Methods of Operating Water Gas Machines." The concluding number will detail "The Operation of an Ideal Shop," as outlined by Mr. C. B. Strohn, of Elgin. We rather know that the Association has done most excellent boosting for the gas business of Illinois, and we are certain that, good as its former methods in that direction have been, those efforts were only as a moving prelude is to the effect of the full score.

DEATH OF MR. N. C. DYE.—With much sorrow we report the death of Mr. N. C. Dye, for many years Superintendent of the Rutland (Vt.) Gas Company, who passed away after a lingering illness, the afternoon of the 5th inst. Deceased was born in Poultney, Vt, September 5th, 1831, and his education was gained in the Troy Conference Academy. After entering upon his business career he entered the service of the Peoples Gas Light Company, and in 1872 became its Superintendent, serving as such until incapacitated for duty. He was a staunch supporter of the Company and its aims, and was respected and beloved by the people of Rutland, amongst whom he labored for almost two scores of years. He was a frequent attendant at the meetings of the New England Association of Gas Engineers. His immediate survivors are his widow and 2 daughters, one of whom is the wife of Mr. William E. Musgrave, a well-known member of the staff of the Boston Consolidated Gas Company. The funeral services were held in his late home, 41 Summer street, Somerville, Mass., the afternoon of the 8th inst., the Reverend Milford H. Smith officiating. The services at the grave were conducted under the auspices of Center Lodge, F. and A. M., of which body he had long been a valued member. His name has been on our subscription books since 1875.

CURRENT COMMENT.—

MR. CARROLL MILLER, First Vice-President and Chief Engineer of the Osaka (Japan) Gas Company, writing to the JOURNAL under date of the 13th ult., calls our attention to the fact that the illustrated description given in our issue for January 14th, of the Osaka Gas Company's doings, was originally prepared by him for the Anglo-

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Japanese *Gazette*. Mr. Miller also informed us that he proposed leaving Osaka for America via Europe the first of the present month, and that he will likely arrive in New York about July 1st.

Mr. E. C. Weisgerber, formerly with the Public Service Corporation of New Jersey, has been appointed Superintendent of the Zanesville (O.) Company, vice the late Mr. H. E. Printz.

Mr. Heney I. Lea, who has been in charge of the producer gas division of the Westinghouse Machine Company, Pittsburgh, resigned from that post to engage in the general work of consulting gas engineer. His headquarters will be in Chicago in a location not yet selected. We wish him all possible success, for he is certainly well equipped for the particular work in view.

Mr. Charles H. Printz has been elected to the vacancy in the Board of Directors of the Zanesville Company occasioned by the death of his father.

The change in ownership of the Cleveland (O.) Gas Light and Coke Company has thus far resulted in the following resignations: That of Mr. M. S. Greenough as President, General Manager and Director; of Mr. Charles W. Bingham as Director, and of Mr. Gustavus Hyde as Engineer. Mr. Hyde had been in the service of the Company since 1859.

"W. S. M.", writing from Fall River, Mass., under date of the 11th inst., says: "The employees of the Fall River Gas Works Company were pleasantly surprised recently when they received their pay envelopes. In these were inclosed separate checks drawn on the First National Bank for substantial sums as dividends from the Company for efficient services. There are about 75 employees of the Company who are benefited by this gift, which is practically a profit-sharing dividend. Each person who had been continously in the employ of the Company from January 1, 1906, to January 1, 1907, received a check for 10 per cent. of his total earnings for that period. The checks naturally vary in amount, but all are for generous sums, and are the more acceptable from the fact that it was wholly unexpected. The Company expended in this manner about $5,000, an average of $66.67 for each employee."

S. T. Francis, writing from Chattanooga, Tenn., under date of the 10th inst., says: "The officers and employees of the Chattanooga (Tenn.) Gas Light Company tendered a farewell banquet to Mr. Wilder, who left right after the affair for Mattoon, Ills. Mr. Wilder goes to take charge of the Company's business in the commercial department, and the banquet was to show the appreciation of his coworkers at this point. The banquet was given at the new Imperial cafe, and was a splendid success, especially in view of the fact that that particular day was the opening of this cafe."

The City Gas Company, of Norfolk, Va., has completed the preliminaries towards laying on a supply of gas to the buildings, etc., under the control of the Commissioners of the Jamestown Exposition Company.

The general annual meeting of the directors and shareholders of the Quebec (Can.) Gas Company was held at the appointed time, Mr. Lorne E. Webster presiding. Besides the Board there were quite a number of interested shareholders present, who were disappointed to learn that no dividend would be declared. This, however, was explained by the Chairman in the presentation of the report of the Board of Directors, which set forth that, in addition to the money already expended for recent extensions, the Board made ample provision for the expenditure during the current year for a very large amount of money for further extensions and improvements for the betterment of the service, inasmuch as it was the intention and the policy of the New Board of Directors to make the system up-to-date in every respect, and give a most effective service at reasonable rates. The annual meeting was proceeded with and resulted as follows: Directors, Messrs. W. J. Hinds, Lorne C. Webster and R. H. Smith, Quebec; J. C. Duffield, London, Ont.; R. A. Smith, J. McKee and W. H. Pearson, Jr., Toronto.

It looks that the New Haven (Conn.) Gas Light Company will arrange this summer for the extension of its main system to the outlying districts of Branford, Guilford and Milford.

The Alton (Ills.) Gas and Electric Company has refused to pay the 2 per cent. tax on gross annual receipts from its sales of gas in Alton, the refusal being based on the claim that the city ordinance on such account was not finally made operative. A suit will undoubtedly be the result.

[Official Report, as Furnished by the Secretary.]

THIRTY-SEVENTH ANNUAL MEETING, NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

Held at Young's Hotel, Boston, Mass., Feb. 20 and 21, 1907.

First Day, Morning Session.

The 37th annual meeting of the New England Association of Gas Engineers was held at Young's Hotel, Boston, Feb. 20-21, under the Presidency of William McGregor, Esq., Pawtucket, R. I. In

Calling the Meeting to Order,

the President said: Gentlemen, kindly come to order and the convention will get down to work. The first business will be the reading of the

Minutes of the Last Meeting.

Mr. Morrison—Mr. President, as these proceedings have all been published I move the reading be dispensed with. [Adopted.]

The President—Next will be the

Report of the Directors.

Secretary Gifford read the report of the Board of Directors, as follows:

To the Members of the New England Association of Gas Engineers—Your Directors would make these recommendations: That the following be elected to active membership:

Bowen, A. W., Treasurer and General Manager, Putnam (Conn.) Light and Power Company.

Brown, C. W., Manager, Ipswich (Mass.) Gas Light Company.

Haskins, W. E., Superintendent, Willimantic (Conn.) Gas and Electric Light Company.

Lewis, Wm. M., General Manager, Rockville (Conn.) Gas and Electric Company.

That Storer, E. I., Assistant Superintendent, Boston (Mass.) Consolidated Gas Company (Everett Station); Nicholas, W. B., Superintendent Citizens Gas Company, Quincy, Mass., be transferred from associate to active membership. And that Bursley, W. H., Assistant Treasurer and Secretary, J. H. Cunningham Company, Boston, Mass.; Stetson, G. R., President and General Manager, New Bedford (Mass.) Gas and Edison Light Company; McArthur, J. A., Secretary, Hartford (Conn.) City Gas Light Company; Murray, Jas., Foreman, Boston (Mass.) Consolidated Gas Company, Jamaica Plain Division, and Goodwin, F. M., Assistant Superintendent, Main Department, Boston (Mass.) Consolidated Gas Company, be elected associate members.

They would also report for your consideration the following papers:

"The Present and Growing Need for the General Adoption of a Uniform System of Records and Accounts," by Alex. C. Humphreys, President, Stevens Institute.

"Some Commercial Departments in the West," by E. N. Wrightington, Secretary, Boston Consolidated Gas Company.

"Methods of Removing Naphthaline from a 16-Inch Pipe," by D. F. Burritt, Superintendent, Springfield Gas Light Company.

"Diagram of Changes in Output, 1890 to 1905," by S. J. Fowler, Manager, Charlestown Gas and Electric Company.

"Some Instances of School Room Lighting," by N. W. Gifford, East Boston, Mass.

"The Process of Making Incandescent Gas Mantles," by M. C. Whitaker, Superintendent, Welsbach Company, Gloucester, N. J.

And call your careful attention to the list of questions as shown on the programme.

Respectfully submitted,

N. W. Gifford, Secretary.

The President—Gentlemen, you have heard the report of the Directors. What is your pleasure? How will the report be disposed of?

Mr. Fowler—I move that it be accepted and the recommendations adopted. [Adopted.]

Election of New Members.

The President—The next business will be the election of new members. What course will you pursue? Shall a ballot be cast by the Secretary?

Mr. Barnum—I move a ballot be cast by the Secretary. [Adopted.]

The President—Mr. Secretary, you will cast the ballot. Mr. Fowler will act as teller.

The Secretary—Mr. President and Gentlemen, I hereby cast the ballot for the names as read.

Mr. Fowler—The Secretary having cast the within ballot as announced, the gentlemen named are elected members of the Association.

The President—The gentlemen whose names have been read are elected members. We trust that these new members will share with us all the good things that they acquired by experience in the business that they are engaged in, and we hope they will receive a great many good things in exchange. We trust they will make themselves known to us all, and that they will find the fellowship of the members as pleasant as we have found it.

Vice-President Africa in the Chair—Next will be the President's address.

[For the address of the President, see JOURNAL, March 4, page 355.]

COMMITTEE ON PRESIDENT'S ADDRESS.

Vice President Africa—Gentlemen, you have listened to a very interesting address, one that contains many valuable suggestions. I will appoint as a Committee on President's Address Messrs. Prichard, McKay and Quinn.

The President—The next business, gentlemen, will be the report of the Secretary.

The Secretary read his annual report, as follows:

REPORT OF THE SECRETARY.

Mr. President and Members of the Association—At the last annual meeting there were elected 9 active members and 13 associate. The resignations were accepted of 2 active and 2 associate members. Death has robbed us of 1 honorary, 3 active and 1 associate members. There are now on the roll 6 honorary, 147 active and 81 associate members.

Copies of Mr. Burdett's report on "Municipal Ownership in England" have been sent to each of the members during the year.

N. W. GIFFORD, Secretary.

The President—Gentlemen, you have heard the report of the Secretary. What is your pleasure?

Mr. Nettleton—I move that it be accepted and placed on file. [Adopted.]

The President—We will next hear the

TREASURER'S REPORT.

Receipts.

Balance on hand, Jan. 1, 1906	$43.39	
Received for dues, 1906	850.00	
" " 1905	100.00	
" " 1904	10.00	
" " 1903	3.00	
" admission fees	95.00	
" advertising	100.00	
" sale of dinner tickets	544.00	
" " proceedings	12.00	
" " report of meeting	118.79	
		$1,876.18

Expenses.

Paid on acct. library	$117.57	
" flowers, deceased members	15.00	
" Proceedings, '04 and '05	361.08	
" printing, etc	207.87	
" Burdett's Rept. Mun. Own	32 30	
" music	27.00	
" postage	2.06	
" hotel expense	624.45	
" report of meeting	104.80	
" salary	300.00	
" telegrams	.50	
" sundries	5 35	
Balance on hand Jan. 1, 1907	78.10	
		$1,876.18

N. W. GIFFORD, Treas.

Cash in E. B. Savings Bank	$336.72
Col. Trust Co	78.10
	$414.82

Examined and found correct. B. J. ALLEN, D. D. BARNUM, } Auditors.

The President—Gentlemen, you have heard the report of your Treasurer. Is there any question that you would like ask? If not, and if there is no objection, the report will take the usual course. Next will be

THE READING OF CORRESPONDENCE.

Have you any correspondence to read, Mr. Secretary?

The Secretary—Mr. President, I have some correspondence, and with your permission and that of the members I will read it by signatures only. It is mostly in the form of letters of regret. The acceptances I suppose will speak for themselves. We have letters from Messrs. F. L. Bradley, James Dunbar, A. S. Miller, F. S. Benson, Alonzo R. Weed, F. R. Persons, Thomas E. Byrne, F. Egner, W. R. Beal and F. H. Shelton, expressing their regret at not being able to meet with us, and most of them extending their cordial greetings to their friends.

The President—There are no special committees to be heard from, with one exception—the Committee on Electrolysis. Mr. Secretary, who composed that Committee?

The Secretary—I think Mr. Prichard is Chairman.

The President—Is Mr. Prichard with us? What was it; a committee of one?

The Secretary—Mr. Addicks and Mr. Allyn, I think, were the others.

The President—Is there any report coming from that Committee on Electrolysis? If not, we will proceed to the next order of business. Dr. Humphreys is not in the room, is he?

A DISCUSSION ON TAR AS FUEL.

The Secretary—Mr. President, although the subject of the President's address has been disposed of there is one point in it to which I would like to call the attention of the members, and that is in regard to the disposal of tar and the recommendation which he made, which I have no quarrel with. I would also like to express my private opinion that another outlet for our surplus tar is in our own works in the fuel problem. I think one or two members of the Association perhaps can back that up with better experience than I can.

The President—The remarks of the Secretary are to the point. We all know that tar is being used to great advantage under boilers in the benches. On my right hand is one who has had as much knowledge of this as any member of the Association. Mr. Africa, we will be very glad to hear anything that you might have to say on the subject.

Mr. Africa—Mr. President, I have not brought any figures with me to give you results, but we have been burning tar very satisfactorily and economically. One of our men is here from Manchester, who I think could give us the amount of tar used per bench per day. Mr. Smith, have you those figures in mind?

Mr. Smith—We have been using about 100 gallons a day per bench of 6's—per day per bench—and getting a yield of about 5.

Mr. Africa—That is about the average working duty throughout the year—we have been running for several years—an average of 100 gallons per bench of 6's per 24 hours.

Mr. W. A. Learned—What kind of tar?

Mr. Africa—That is coal tar. We have also used some water gas tar for the same purpose, and it answers just as well.

The President—Do you get any smoke, Mr. Vice-President?

Mr. Africa—No smoke trouble at all. You have to give the bench plenty of air.

Mr. Fowler—Any other fuel used?

The President—Any other gentleman who would like to speak on the question of coal tar burning while we are waiting for the next speaker we shall be very glad to hear from.

Mr. Fowler—Are those benches run exclusively on coal tar; no other fuel used?

Mr. Africa—No other fuel used. We use a small amount of coke to start the bench in the first place, and then there is enough heat in the bench to keep that tar burning.

APPOINTING SPECIAL COMMITTEES ON OBITUARY RESOLUTIONS.

The President—I will appoint the following Committees on Obituary Resolutions:

On Mr C. F. Thompson—Messrs. A. F. Cooper, F. H. Parker and Henry H. Kelly.

On Mr. J. H. Armington—Messrs. C. H. Nettleton, C. Dudley Lamson and C. F. Spaulding.

On Mr. A. C. Pease—Messrs. C. F. Prichard, H. K. Morrison and J. A. Coffin.

On Mr. Frederick W. Thomas—Messrs. H. A. Norton, J. A. Gould and Charles S. Spaulding.

On Mr. H. A. Allyn—Messrs. Waldo A. Learned, Samuel J. Fowler and H. L. Coggeshall.

On Mr. F. P. Fairbanks—Messrs. Andrew K. Quinn, F. M. Travers and Norman O. Goulding.

We have now with us Dr. A. C. Humphreys, and will be very much interested and pleased to listen to a paper that he has very kindly prepared, entitled, "The Present and Growing Need for the General Adoption of a Uniform System of Records and Accounts."

Dr. Humphreys—Before reading this paper I wish to have it distinctly understood that I have no intention of treating of the merits of the 80-cent gas litigation now before the United States Courts. I intend to refer to certain facts in connection with the recent New York investigations which have to do with the need of a uniform system of accounts and records. And I feel that this need has been so abundantly demonstrated in these investigations that the opportunity must not be lost of raising my voice in warning and protest as to the improper use

of certain published records by men who attempt to serve as experts. I would also announce that I have changed the title a little, to

THE PRESENT AND GROWING NEED FOR THE GENERAL ADOPTION OF A UNIFORM SYSTEM OF RECORDS AND ACCOUNTS.

[For the first chapters of the paper by Dr. Humphreys, see JOURNAL, March 11, page 398.]

On page 116, of the 1906 Report of the Massachusetts Commission, covering the year ending June 30, 1905, there is a table showing certain data in regard to the gas companies. One column is headed "Capital Per Thousand Sold, Including Bonds." Upon analysis, using the individual reports in the appendix, it is found that "Notes Payable" are included in this statement of fixed capital. I so analyzed these statements and confirmed the accuracy of my analysis by referring the question to the Chairman of the Commission. Now, Prof. William D. Marks, in testifying in the Consolidated case as previously referred to, attempted to show that for certain of the Massachusetts Companies the working capital, or the active capital as he called it, being the difference between the quick assets and the floating debt, was only 13 cents per 1,000 of annual sales, this figure being obtained by including the notes payable in the floating debt. In my analysis of the returns of these companies, I included the notes payable in the fixed capital and consequently excluded them from the floating debt, and so the quick assets of these companies selected by Prof. Marks rose from 13 cents per 1,000 to 43¾ cents per 1,000. And here is to be seen a curious phase of human nature. Although Prof. Marks had originally qualified his quotation from these Massachusetts reports by stating that these reports were recognized as unquestioned authority, when this unexpected result of my analysis was developed he attempted to recover his lost ground by asserting that the figures shown in the column to which I have referred, and which included notes payable as fixed capital, were incorrect, due to the Commission employing for this tabulation a statistician who was ignorant as to the principles involved.

Referring to my remarks as to the opportunity for misrepresentation, in my opinion the column referred to should show plainly that notes payable as well as bonds are included as part of the fixed capital.

Following up his work on the witness stand Prof. Marks has recently published an article in the February issue of *Municipal Engineering* entitled "The Cost of Manufacturing Illuminating Gas," and he proceeds to introduce figures from his testimony in the Consolidated Gas case. There are a number of statements in this article which would be rather amusing were it not that, in the absence of contradiction, those looking for data may be led astray.

Prof. Marks says: "Using English accountants' methods for computing the cost of gas;" but it seemed upon cross-examination that he was but little acquainted with English accountants' methods and, furthermore, his testimony was not always in accord with such methods where they were developed in the testimony. He makes very particular reference to this point of active capital and states the amount that should be allowed to the Consolidated Gas Company—and from access to his testimony it is to be seen that he has based his estimate here as he did in his testimony on this 13 cent per 1,000 figure which was proved upon cross examination and by my testimony to be absolutely without warrant. In view of the character of the article, the concluding words are characteristic: "In this city of New York, the regulation of quasi-public corporations, and the consideration of their needs, have not kept pace with their amazing prosperity and growth in size, and should have the immediate consideration of our governing bodies, *assisted by expert analysis of the most thorough character.*" (The italics are mine.)

Prof. William D. Marks is the author of "Finances of Gas and Electric Light and Power Enterprises," which sells for $2.50 a copy, and the author, in a circular which he has sent around to gas companies, including, I presume, the New England companies, advises all managers to buy this volume if they want to run their companies to the best advantage. The circular reads rather like an advertisement of some medicinal remedy—gas men cannot do without it. I advise gas men to buy this little book, for they may find it valuable if they come in contact with Prof. Marks as I did. If all of Prof. Bemis' testimony were to be found in this book, Prof. Marks repeatedly states that an allowance of 5 per cent. on the investment should be allowed for depreciation.

In the Consolidated case Mr. Marks maintained that a certain isolated journal entry made by the Consolidated Company should represent for that year the total depreciation, and the amount so approved by Prof. Marks on the manufacturing plant amounted to .02 per cent. on the book value, or allowed for, say a life of 5,000 years. It is unnecessary to state that he did not draw attention to the length of life of plant involved in his estimate; I am responsible for this addition to his statement. On the whole plant he allowed .8 of 1 per cent., or say a life of 125 years. And this in spite of the fact that he repeatedly states in his book that depreciation for gas companies should be estimated at 5 per cent. on the total investment; and in one case, referring to electric properties, he allows for depreciation to the extent of 10 per cent. In the New York Consolidated case, my total allowance for depreciation, *including current renewals*, worked out to almost exactly 2½ per cent. per annum on the cost of depreciable property alone. This Prof. Marks declared was far too high, in spite of the statements in his book.

Comparing certain 4 Massachusetts companies with New York, which Prof. Marks claimed to be fairly comparable with New York, he showed a structural value of $1.78 per 1,000 of annual sales. It perhaps will take a Massachusetts gas man to appreciate fully the absurdity of the analysis by which this last figure was obtained. My analysis of the individual reports of the companies referred to as found in the appendix showed the *capital* of these companies to be respectively $2.38, $2.29, $2.01 and $2.04; but the book assets, fixed and working, were $3.96, $3.50, $3.24 and $3.40. Understand, these were the book value of assets. Now, I made a further analysis and compared the book values of mains and meters with the values as derived from the schedule of those assets, and, using moderate valuations for the meters and for the mains, a valuation which Prof. Marks had stated as applicable to work outside of city limits, which allowed for no expensive pavement, I found that the corrected assets for the first three were respectively, $4.38, $3.80, $4.38; the last one I was unable to correct because the assets were not divided on the balance sheet. It is also to be noted that a full correction was not made because there were no schedules of services and manufacturing plant. It is reasonable to suppose that a complete correction including these two divisions of plant would have increased the difference between actual and book values.

This brings me to a point which is very noticeable in the Massachusetts accounts and which I submit requires careful consideration at the hands of the Massachusetts Companies and the Massachusetts Commission. Prof. Marks particularly referred to the structural assets of one Massachusetts Company in connection with some of his analyses. An analysis of the statements of this Company showed that, during a period of 5 years, there had been a decrease in the book valuation of mains of about 9 per cent., whereas the actual value derived from the schedules had increased almost exactly 104 per cent.; and, furthermore, that the actual value at the first of the period was 3½ times the book value. This unquestionably is an extreme case, but it goes to demonstrate that the book value of fixed assets, as shown by the Massachusetts Companies in their published reports, do not indicate by any means the actual investment in those assets. And here it is to be appreciated that men like Prof. Bemis and Prof. Marks go on the stand, avail themselves of these published records and from these records make the argument that the amounts shown by the Massachusetts Companies as capitalization per 1,000 or assets per 1,000 are a safe criterion in the case of other companies. In other words, they claim that because they find a certain company has a book valuation for structural assets of say $2, that figure can be safely assumed as the cost of the plant necessary for the supply of a district conditioned somewhat similarly. And, furthermore, it requires cross examination to bring out the acknowledgment that, in addition to these structural assets, an allowance must be made for working or active capital; and, further, as I have shown, unless the returns as published are perfectly self-explanatory, such a man as Prof. Marks can appear on the stand and claim that the active capital should not exceed 13 cents per 1,000, although the very records from which he is drawing his conclusions show, if competently analyzed, that there is required 43¾ cents per 1,000.

Again, "experts" of this kind refer to the Massachusetts reports, and, making convenient selections, show a very low capitalization per 1,000 of annual sales and then argue that this should establish the maximum upon which other companies should be allowed to pay dividends. The average capitalization of the 32 Massachusetts gas companies engaged exclusively in the gas business, according to the 1906 report, is $2.88 per 1,000 annual sales. But I have already shown how the actual capital invested in fixed assets plus the working capital is far in excess of the capital, including stock, bonds and notes payable; so it is again seen how the Massachusetts Companies, in their reports as published by the Gas Commission, furnish a most misleading comparison in the hands of incompetent or designing men.

The experts and counsel for the city and State, in the case of the Consolidated Gas Company, referred to repeatedly, made reference to the

Massachusetts reports. On the last day on which testimony was taken under cross examination I was asked the following question: "With respect to the profits, the Massachusetts gas companies are allowed to make and could put into their plant, aside from what they pay out in dividends and interest, you are aware, are you not, that it has for many years been the position taken by the Massachusetts Gas Commission, that, if profits are put into extensions, the time will ultimately come when the plant, being thus paid for, the price of gas will be so reduced as to include only a return on such capital as has been actually put in by stockholders?" This is an exact copy from the record before correction, and hence a little mixed. I replied that I didn't know anything of the kind. Finally, counsel for the city read into the evidence, by incorporating it in a question to me, a large portion of the statement appearing in the 16th Annual Report of the Massachusetts Gas Commission in reference to the well known Haverhill case.

I do not contend that counsel for the city of New York in this case (no doubt coached by Prof. Bemis) correctly interpretated the attitude of the Massachusetts Commission, but the opinion as quoted by counsel seems to me to put the Massachusetts Commission in this particular case somewhat in sympathy with the attitude of the Chairman of the New York Commission when he stated, unofficially it is true, that before he got through he proposed to squeeze out of every New York State Gas Company every drop of water contained in their capital.

Here the question first to be decided is: "What is water?" The question of form of capitalization at once comes in. You may remember that The Gas Light and Coke Company, of London, was allowed some years ago to convert its smaller amount of higher dividend rate stock into a larger amount (almost exactly double) of lower dividend rate stock. In other words, it was recognized that the rate of capitalization must depend upon the rate of return, and the rate of return must depend upon the rate of capital. It was thus recognized that there is no greater burden upon the Company nor upon the public whether we pay 10 per cent. on say $3 or whether we pay 5 per cent. upon $6 per 1,000.

Referring to the Haverhill decision by the Massachusetts Commission, if surplus (quoting from the Massachusetts Commission Report) "Is by every principle of law the property of the corporation," and if "it (the corporation) has an undoubted legal right to distribute it (surplus) as a dividend as it is required or *pro rata* to its stockholders in case of liquidation," has not the corporation a right, morally at least, to distribute this surplus later or to sell this surplus to a successor? And especially so if, as the Commission states was the case with the Haverhill Company, only an average of 8 per cent. had been distributed on a low rate of capital; had not charged extravagant prices; had not pursued a niggardly policy towards the public; had accumulated the so-called surplus in part by exceptional care and management; and if these savings from the business had not been made, the property in which the surplus was invested must have been represented by new capital, contributed by stockholders.

Let us look a little closer into this "average of 8 per cent." The Massachusetts Committee reports only go back to 1886, so there is no record of the dividends paid before then. There was no return for 1886; for the next 11 years 10 per cent. was paid, but upon a capitalization varying from $2.19 down to $1.429, the highest dividend in cents per 1,000 being 21.9 cents. In the next year, 1898, the rate was raised to 13 per cent., but this was on $1.103 per 1,000; the next year 50 per cent. on $1.164 per 1,000, including notes payable or 43.70 cents per 1,000 for dividends alone (stated in the report as 4.37 cents); the next year 20 per cent. on $.818 per 1,000 or 16.35 cents; the next year 30 per cent, on $.652 per 1,000 or 19.56 cents; since then no dividends have been paid. Thus it is seen that even the 30 per cent. dividends made an extremely low charge per 1,000 feet sold; and it is also clearly seen how the rate of return upon capital is no criterion for comparison unless the rate of capitalization is also considered.

In this opinion of the Commission it is also stated that part of this so-called surplus would be required to replace and extend plant. So much of the so-called surplus as was required to replace or renew plant —in other words, to take care of depreciation— was not surplus except in name.

I am not attempting here to defend the real watering of capital. I am not concerning myself with the Haverhill case as far as that is concerned, if such was attempted. I am simply concerning myself with the statement made by the Commission and comparing that with the statement made unofficially by the Chairman of the New York Board. Is it not a severe enough condition if gas companies are held down to paying dividends or returns only upon the actual amonnt invested and employed? Apparently in the Haverhill case, the stockholders had contributed directly $75,000 as capital; but unquestionably large additional amounts which had been put into plant had been indirectly contributed by the stockholders from their legitimate profits. For the report referred to admits that the dividends had been moderate through a series of years and that the management was excellent. The figures I have given alone show that the dividends per 1,000 of sales were less than moderate. Why then was the Company not entitled to the savings made by its excellent management, at least to the extent of a full return upon the *actual investment*? Does it make any difference in fact whether a 10 per cent. dividend is paid and then the stockholders are required to put back 2 per cent. as additional capital, or whether only the net amount of 8 per cent. is paid to the stockholders? The 2 per cent. invested in extension of plant is just as much the property of the stockholders as the 8 per cent. given to them in dividends. The Company simply put the 2 per cent. in the bank in the form of gas plant and this should have been for the benefit of the stockholders if at any time they decided to realize through a sale. And here it must be fully comprehended that the Haverhill Company had only paid moderate dividends upon an absurdly low rate of capitalization.

I trust that counsel for New York city in the quotation referred to has not correctly interpreted the opinions of the Massachusetts Commission. He unquestionably meant that it was the intention of the Massachusetts Commission to cut down the capitalization of the Massachusetts companies until they would only be allowed to pay dividends upon the capital paid in as such by the stockholders. For instance, in this case of Haverhill, they were to be cut down until the capital to be paid on at, say 10 per cent., was only $75,000, which amounted at the time of the Sixteenth Annual Report to 65 cents per 1,000 of annual sales, or the present time to a capitalization of 63 cents per 1,000 of annual sales. This would be a profit of 6.3 cents per 1,000 sold. Such a proposition is ridiculous on its face; but apparently it is only by following a matter of this kind to the point where it is ridiculous that some people can be brought back to what is sane and reasonable. It is encouraging to find that this decision of the Massachusetts Commission has not been upheld by the courts.

It is proper that gas companies should provide fully for depreciation. But here we are met in the New York Consolidated Gas Company's case with the proposition by the "experts" for the State and city that even the average annual expenditures for repairs and renewals constituted an overestimate of cost and should not be allowed, and that the expenditures so made, amounting to 10.89 cents per 1,000 feet sold, really added to the value of the investment. Now, if this proposition is coupled with the proposition that you cannot put in additional capital to the full cost of the additional plant, the gas companies are certainly between the upper and nether mill stones. And is it not true that, even in Massachusetts, the Commissioners have at times been somewhat inconsistent in this regard, attempting in their hearings to limit too closely the amount to be charged to repairs and depreciation as unduly increasing the statement of cost on the one hand and, on the other hand, limiting the amount of capital to be raised to cover additions and extensions?

The proposition to my mind is a perfectly simple one as a statement of principle, but possibly somewhat difficult to apply in practice, namely, that all the legitimate expenses of the business, including repairs and renewals, plus an allowance for accruing depreciation, should be included in the statement of cost of gas, and that all legitimate extensions should be paid for by new capital. In other words, that a full return should be allowed upon actual capital employed, and that the price should be based upon a statement of the actual cost of gas. Furthermore that, where the price of gas is to be fixed, there should be a reasonable reserve allowed to accumulate to cover fluctuations in the cost of material and all extraordinary contingencies. And I have not hesitated in the New York cases to claim that 5 cents per 1,000 should be allowed for reserve until an accumulation of 1-tenth of the capital has been secured.

In this 5-cent reserve I have included the extraordinary hazard of electrolysis, the cost of which it is at present impossible to accurately appraise and, therefore, was not included in my estimate of accruing depreciation.

During the year 1902 a committee of the American Gas Light Association, appointed 2 years before to report on a uniform system of accounts, brought in its final report. I had the honor to be chairman of that committee. The committee worked conscientiously through 2 years and brought in its conclusions, subject to certain modifications which might be made as a result of additional suggestions immediately thereafter to be made by the members through the mail. A few months later the report of this committee was published and, in accordance with a resolution of the American Gas Light Association, was adopted as its standard uniform system of accounts.

One radical defect in this report was the omission by the committee of a definite recommendation on the question of depreciation. This was not due to any opinion on the part of any member of the committee that depreciation should not be cared for. But there were differences of opinion in the committee as to whether that was a matter with which the committee had been charged to deal.

The committee rendered a report of progress at the meeting of 1901, and the draft, as at first prepared, contained a very decided pronouncement in regard to the necessity of caring for depreciation in a methodical way. All the members of the committee were not present at that meeting and it was, therefore, impossible, in view of the differences of opinion, to render the report in this form. Later the committee failed to agree on a statement to cover this most important subject and, under pressure to complete the work within the promised time, the subject was, unwisely, I now confess, pushed to one side. Personally I have never ceased to regret that the committee did not agree upon some statement in this connection and that, failing to agree upon a definite statement, the members of the committee did not at least recommend that the matter should be further considered and request that the subject be recommitted to enable the committee to complete its work in this regard.

The prudent New England industrial manager inclines to a liberal writing down of the book value of assets. If a concern owning a cotton mill or a shoe factory wishes to carry a $500,000 plant on its books at a nominal valuation of $100, simply to keep the account open, that is nobody's business except the owners. But the proposition is very different in the case of a public service corporation subject to investigation and control.

Even such a policy of writing down of assets as has generally been followed by the Massachusetts Companies, partly of their own volition emanating from this New England prudence, and partly under pressure from the Gas Commission, is unjust to their stockholders and unjust to the stockholders of other United States gas companies.

The money actually invested and employed in the business should be shown in the asset accounts and should be represented by capital; and provision should be made for the issuing of capital in excess of the value of active tangible assets *provided the rate of return is properly adjusted and controlled*, and the undertaking could thus be more readily economically financed. It should be recognized that the gauge of rate of return should be found in the cents per 1,000 and not in a fixed rate per cent. on a variable rate of capitalization.

In any case money honestly expended on plant should be shown on the books as an asset, and local conditions should be considered in any analysis of the rate per 1,000 of capital investment so represented. It is absurd to the last degree to say that, because a certain company shows on its books assets of only $2.50 per 1,000 of annual sales, $2.50 should be set up as the standard rate of capitalization of all other companies. If one or more companies so write down their assets to such a rate, either willingly or under pressure, it should be shown on the face of the returns that this does not represent the actual capital employed.

The fact is that no fair comparison can at present be based upon the surface indications of published reports. We are all familiar with the great injustice done both here and abroad to private management of public utilities, when compared with that of municipal management. The comparisons made by schoolmen, theorists and politicians with axes to grind, are made to appear unfavorable to companies because the accounting is along lines widely apart. The companies have not a tax budget to cover deficits. In the United States the shutting down of nearly 200 municipal plants has demonstrated the weaknesses not disclosed by the yearly accounts of these undertakings.

But we must not learn our lesson through the same harsh experience. It must be borne in mind that the enemies of public service corporations are abroad and active, including the so-called experts who are striving to establish a reputation as destroyers of values, which will tend to secure them steady employment at $50 a day. The time has come when our books should be kept irrespective of any policy except the policy of showing the facts by standard and approved methods. In the past there has not been a uniform policy in this regard, and sometimes our directors have indicated a policy in the keeping of accounts which was not calculated to show the facts most plainly. But the directors will find themselves better able to decide as to questions of management and policy if the reports are presented to them according to a complete uniform method.

Not infrequently the directors are deceived by the reports made to them, while those who make the reports are innocent of any intention to deceive. Every manager of a gas property should be competent to direct as to the minutest detail of the accounts, and this will be easier for the majority if a uniform system is available which can be adopted with confidence.

The question of depreciation is perhaps the most difficult of all to be solved, and especially so as no general rule can be established which will be capable of application to all companies without adjustment. But the questions involved must be faced. While it is true that no uniform rate of depreciation can be fixed for general application, owing to the variations in conditions, it is nevertheless true that uniformity as to principles can be made applicable to all cases. At present this whole subject is in a condition of chaos, and this gives the opportunity to those who are investigating our affairs with no friendly intention.

It must be remembered that depreciation is an actual loss to be included *each year* in our final cost of gas at the burner. Part of this cost must of necessity be based upon estimate because it is accruing. If our estimate is too low, we show too low a cost, hence too high a profit, and at the same time show too high a book value for our assets. On the other hand, if our estimate is too liberal, we show too high a cost, and hence show too low a profit and at the same time too low a book value for our assets. If we are to be controlled in our rates of charge by reference to the book value of our assets, then this overestimating of depreciation means the constant writing down of our assets, as has been the general practice in Massachusetts. This may commend itself on the score of prudence, as practiced by concerns not subject to supervision; but how about the stockholder of the future of public utility corporations if this process is to continue without check?

Depreciation should be estimated with the greatest possible accuracy, and our estimates should be checked from year to year by comparison of book values with appraised actual values. Our assets should be shown as nearly as possible at their actual worth; no more and no less. Our books should show the facts and should show them on their face without the need of straining for interpretation.

I have shown the dangers to be apprehended from the ignorance of legislators and investigators and from the testimony of "experts," who either intentionally or through ignorance misinterpret the records available for analysis. It is unfortunate that, under the conditions as they exist with our form of government, men at once capable and honest have not been willing to accept retainers against the gas companies.

Naturally the men of our profession do not wish to pull the chestnuts out of the fire for politicians. The result has been that those investigating gas companies have necessarily been dependent upon men incompetent, if not worse. But if men of standing could be assured that they would be permitted to testify the truth, the whole truth, and nothing but the truth, I am of the opinion that it would be of distinct advantage to the gas interests of America to have the competent and responsible gas men accept retainers on the side of the investigators. In Great Britain, men of standing do so appear on both sides and they do not lose reputation thereby. Our business is now threatened by those who wilfully or ignorantly misinterpret the data in their hands and our safety lies in a complete and general understanding of the facts. It should be made as easy as possible for the honest amateur reformer to learn the facts.

Therefore, I now submit that the time has come for the gas men of the United States to earnestly co-operate with the purpose of developing such a uniform system of accounts, records and returns as will commend itself for general adoption. We have as a basis the system adopted by the American Gas Light Association; but this should be supplemented at least in the matter of depreciation. And the effort should be made to induce the State Gas Boards to adopt the uniform system, as finally developed, and to co-operate with the gas companies in developing a system of returns and published reports that would be as far as possible uniform and self-explanatory. Such a system must include a complete classification schedule of items as is included in the "Uniform System" of the American Gas Association.

The gas men in Massachusetts now in the room know perfectly well that the returns as now made are not uniform and there is not any complete classification list which decides where every item of expense shall be placed. To my personal knowledge, there is quite a wide variation of practice in regard to certain items of operating cost. This must necessarily lead to unfair and injurious comparisons in connection with the published returns.

I trust that it may commend itself to this Association to propose to the American Gas Institute and to the local Associations scattered throughout the United States, that the work I have referred to should be undertaken by a joint committee; or that a joint committee from this Association and the Gas Institute should be appointed for the purposes I have advised, when no doubt the report brought in and adopted by this Association and the Institute would gain the active, loyal support of the local Associations scattered throughout the United States. With the gas men of the United States thus combined in an honest, intelligent effort to improve conditions along the lines discussed, I believe that they could reckon upon securing co-operation of a majority of the membership of the Massachusetts and New York Commissions and of those likely to come into existence.

[To be Continued.]

[Concluded from page 405.]

Report of Committee on Standard Methods of Testing Fuel Gas Appliances, Submitted to the American Gas Institute, Chicago, October, 1906, on Behalf Ohio Gas Light Association.

Method of Testing Instantaneous Water Heaters.

This method is similar in principle to the method of testing circulating heaters, the connections being made as shown in Fig. 7. As some

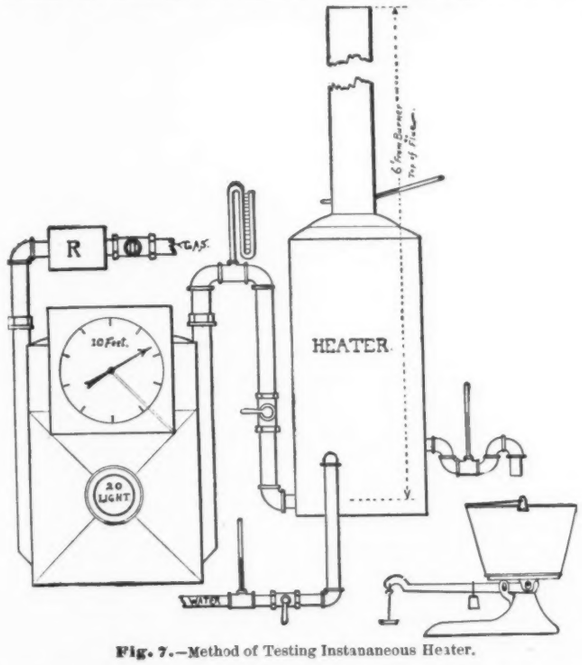

Fig. 7.—Method of Testing Instantaneous Heater.

of these heaters are designed for large gas consumption, a service, meter and regulator of ample capacity must be used. A 20-light meter tested for accuracy may be arranged as shown in the figure, with a large dial calibrated to tenths of a foot, and with the hand attached to the spindle of the 10-foot hand on the original meter dial.

A rubber band, placed loosely over the spindle and one corner of the large dial as shown, will take up the back-lash of the train of gears in the meter, making it possible to estimate readings to hundredths of a foot. The water supply is the same as for the circulating heaters. A thermometer is placed in the water supply pipe near the heater, and a special cock, such as that shown for circulating heaters, is used to control the rate of flow, unless a good valve is supplied by the maker attached to the heater. Another thermometer is placed in the outlet pipe, trapped as shown in the figure, and the water caught as before and weighed. Those heaters having automatic controlling devices should have them cut out or removed during the tests. A flue is supplied, the top of which is 6 feet above the burner. The first test is to determine the efficiency of the heater at maximum consumption of gas, and with the flow of water adjusted so that a 50° rise in temperature is obtained. Similar test is then made for each multiple of 5 feet gas consumption down to 20 feet, with a 50° rise in the temperature of the water in each case. Then, with the same rates of gas consumption as before, a similar set of tests is made, except that the water is drawn off at a temperature of 120° in each case. By plotting curves of the results obtained from each test it will be readily apparent, when the requirements of a particular case are known, which heater should be supplied.

Discussion of Gas Ranges.

The very large number of gas ranges which are at present in use is sufficient indication that they have generally met with public approval, and there is no doubt that, compared with other methods of cooking, the gas range has no rival. Nevertheless, every gas manager knows that gas is not the most economical fuel, and this is the only reason for the gas range not being adopted by every individual situated where gas can be obtained. This being the case, it would seem entirely to the gas companies' interests to make a gas range as economical as possible. There is no doubt that, where any gas apparatus is used for a variety of purposes, it is difficult to obtain high efficiency for each purpose, and this is probably the reason for the low efficiency of a gas range. For instance, though we have 3 different sizes of burners on the top of a range, under no condition does their efficiency run much above 50 per cent. If it were possible to permanently place standard vessels on the top of a gas range much higher efficiency might be expected, for then the burners would be arranged to do specific work. While the top burners are arranged as at present, the accompanying test will show their efficiency under good working conditions, and is much to be preferred to either the test by evaporation or by raising the temperature of a certain quantity of water a known amount in an ordinary vessel, as the condition established by this test may be maintained as long as necessary to check the results obtained.

The oven also is required to be used for numerous purposes, such as the baking of a light cake, requiring a temperature of less than 300°, or a batch of biscuit, requiring a temperature 100° higher. Then, also, many people will use their ovens for roasting, though our modern cooks prefer to use the broiler, and, of course, where the ovens are used for this purpose a still higher temperature is at times desirable.

Owing to these various requirements, it would be difficult to make a standard apparatus for determining the actual efficiency of a gas oven. Consequently, in this case comparative tests which are very simple will be used, and as far as gas companies are concerned quite sufficient. All the heat of the gas, when nothing is removed from the oven, must eventually pass out by the flue or by radiation. If each of these losses is determined, the manufacturer may readily find where an improvement is possible. The methods of determining the total flue loss, and also that loss which is occasioned only by over-ventilation, that is, the heat which is carried out by the air passing through the oven which is not necessary to support combustion, are both described elsewhere.

To determine the relative value of insulating material used to prevent radiation, a very simple and effective method is to place say 25 pounds of loosely coiled copper wire on the lower rack in the oven, by lighting the oven burner bring the temperature somewhat above 600° then turn out the fire, close the flue and take successive readings of the temperature of the oven by a thermometer, the bulb of which is in the interior, and the graduations or stem outside the oven where it may be read. The curve of this fall in temperature, when compared with curves made under similar conditions, but in other ovens or with other insulating material, will readily show which is superior.

In making an oven the object sought is an inclosed air space highly and evenly heated. It is apparent that a very thin wall of iron would not keep the temperature of the inclosure as high as a heavy wall of non-conducting material with the same supply of heat, and if an excessively large flue with heavy draft were used a lower temperature would be obtained than with a flue of just sufficient size and with just the draft necessary to carry off the products of combustion. Is there not room for improvement here?

The broiler, the work of which can be duplicated in no other domestic appliance, is usually arranged in such a way that one is led to suspect that the designers are not cooks.

How it was ever possible to induce a lady, and more than half the ranges are used by the lady, to get down on all-fours and watch a piece of meat broil is hard to understand. But they do it, and they will continue to do it, so long as their delicious steaks and chops cannot be duplicated in a more convenient manner. It is no wonder she has given the elevated broiler such a hearty welcome. The side broiler has not been overlooked, but slight investigation will show that a majority of them go to houses where help do the cooking. The work of the broiler, or some broilers, could hardly be improved, but the efficiency is very low; in fact, lower than any other part of the range. Again, there is evidently room for improvement.

Method of Testing Top Burners of a Range.—The top burner may be tested in two ways; the simpler and less accurate is to evaporate water over the burners. On account of the variation of the boiling point, due to changes of atmospheric pressure, the impurities in the water, and the fact that much of the work of the top burners is bringing water to the boil, make it a rather doubtful test of actual efficiency, and tests by this method are usually several per cent. below the results obtained by the following method, which we recommend.

Fig. 8 shows a copper pan, 10 inches in diameter and 8 inches high, containing a concentric pan which is 8 inches high, 9 inches in diameter, hermetically closed top and bottom, and supported ½ inch from the bottom and sides of the larger pan by slender supports.

The purpose of the inner pan is to displace a quantity of water and thus cut down the thermal capacity of the apparatus. Four inches from the bottom of the outer pan is an overflow, arranged as shown, in such manner that the overflow water will have to pass through a U-trap containing a thermometer before exit. The overflow opening should be rectangular and 1 inch wide, and the opening for the hose

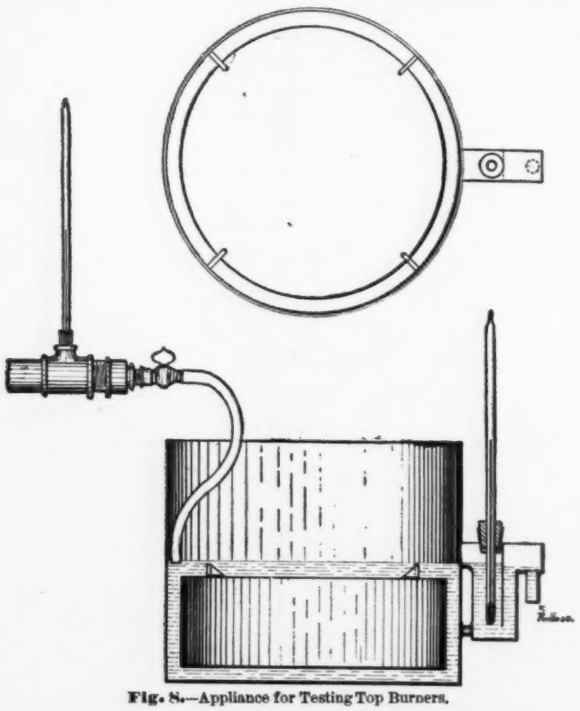

Fig. 8.—Appliance for Testing Top Burners.

connection should be about ½ inch lower so that the level of the water in the pan will remain at practically 4 inches. The water is supplied from a constant head, of known temperature, the manner shown being convenient, and the overflow is caught and weighed. The test is made by allowing a small quantity of water to flow through the pan and the burner lighted at full consumption of gas under 2 inches pressure, then the flow of water is adjusted so that a 50° rise in temperature is obtained. When conditions have become constant a convenient quantity of water is weighed off and the amount of gas used while the water is being collected is noted. The heat units collected by the water divided by the total B. T. U.'s in the gas measured will give the efficiency of the burner under good working conditions.

Method of Testing Range Ovens.—To avoid complicated or troublesome methods necessary to determine actual efficiency, a deviation is here permitted and a comparison of the ovens only is made. A stem thermometer, registering to 600° F., is inserted through a hole in the top of the oven as near to the center as possible.

Asbestos paper may be put around the stem of the thermometer and then dried in any shape necessary to best support the thermometer. Tests are made starting with 10 feet for every multiple of 5 feet to the maximum flow, as follows: The gas is adjusted to the desired rate of flow without being lighted; then shut off by another cock—there is always one back of the meter—so that the adjustment will not be changed and given time to clear from the appliance. It is then lighted and readings of temperature taken each minute to get the curve of rise until the maximum temperature is reached. A comparison of the results obtained from each oven will readily show which is superior. If it is desirable to know the flue loss, see the article on that subject.

Method of Testing Range Broilers.—The efficiency of a range broiler is determined by the apparatus illustrated in Fig. 9. It consists of a flat closed copper pan, 10 inches in diameter, 1 inch thick, closed tight top and bottom, and with a parting diaphragm of copper half way between the heads, with small perforations near its periphery. The water is supplied from a constant head of known temperature through a ¼-inch brass tube to near the center of the lower chamber; it will spread passing to the upper chamber through the holes near the circumference of the parting diaphragm and then to the center of the upper chamber, from which it is drawn down and out by another ¼-inch tube extending up from below through the lower chamber and almost touching the upper cover.

A slight pressure of water on the inside of the pan will raise the upper cover in the center sufficiently to allow the necessary amount of water to pass out, and the slight rise in the center will cause the water, from all sides, to flow into the center, provided it is placed perfectly level. The top of the pan should be just 2 inches below the bottom of the flame, and must be central, otherwise, in the broiler. The upper side of the pan must be a dead black, readily obtained with a coat of

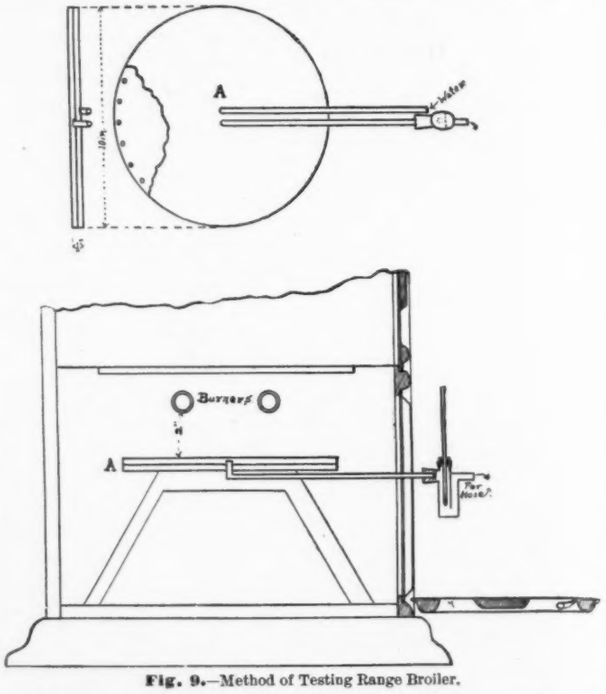

Fig. 9.—Method of Testing Range Broiler.

lampblack mixed with spirits of turpentine, and laid on evenly. The door of the broiler is left open and a door of sheet iron made to fit in its place, as shown. This door must give the same insulation and ventilation which the original door had. The water supply and return are brought through this door and its temperature determined at both these places. The appliance for determining the temperature of the broiler overflow is shown in Fig. 10, while the supply may be the

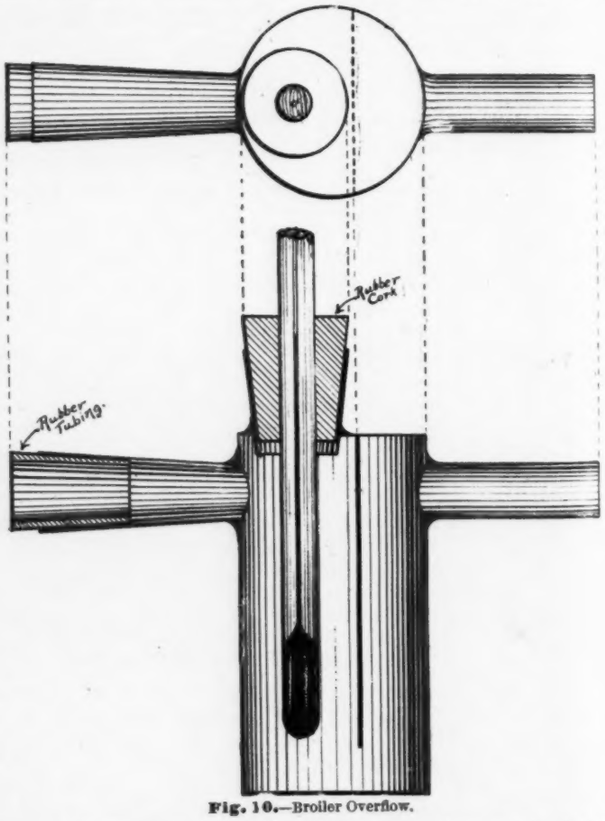

Fig. 10.—Broiler Overflow.

same as for the top burner tests and the temperature obtained in the same way as shown in the illustration of the appliance for testing top burners.

Flue Loss.—There is a great difference in the amount of heat lost in the flues of different appliances, the loss in water heaters being very much less than that of a range, but there is great over-ventilation in

all. The method of determining the total loss in the flue and the loss due to over-ventilation is each given, and it will certainly be found worth the while of any manufacturer to become familiar with them. The gas company is not particularly interested in knowing where the losses occur in an appliance, they only wish to know which one gives the highest efficiency.

The Total Loss in the Flue.—The total loss in the flue consists of the heat carried off by the flue gases due to their increased temperature over that of the room and the service gas, by the latent heat of the water vapor formed by the combustion of the hydrogen in the gas, and its rise in temperature. The following method will show what per cent. of the total heat in the gas passes out of the flue:

From an analysis of the service gas determine the total hydrogen (H) and carbon (C) in 1 foot of this gas by weight of 32° and 30 inches. Analyze the flue gas with an Orsat apparatus, a description of which follows, and find the per cent. by volume of carbon dioxide (CO_2), oxygen (O) and nitrogen (N) contained in it. Then assume a sample of 100 cubic feet of this flue gas. Multiply the per cent. of CO_2 in the flue gas, which may now be called feet by .12267, which is its weight per cubic foot under the assumed conditions of 32° F., and 30 inches barometric pressure. Then three-elevenths of this product will be the weight of C in the assumed sample. This weight of C just found, divided by the weight of C in 1 foot of the service gas, will give the number of feet service gas proportional to the flue gas sample. Having now a known number of feet of service gas, this quantity, divided by the weight of H in 1 foot of service gas, will give the weight of the H in the flue gas sample of 100 cubic feet.

Nine times this weight of H just found will give the weight of water (H_2O) vapor which passed the flue during the sample. The weight of H_2O vapor, times its specific heat, which is .48 approximately, times the difference in temperature between the flue and the boiling point of water at the particular location where the test is made (sea level 212°, and Denver 202°), plus the weight of H_2O vapor, times the latent heat of water for the barometric pressure of that location. This latent heat for sea level is 965.7, while for Denver it is 972.9, which shows the possible variation (the table on page 663 of Kent's Engineers' Pocketbook will give the required data), plus the weight of H_2O vapor, times the difference in temperature between the room and the boiling point of water (times the specific heat of water which is 1), will give the total B.T.U.'s. of heat lost in the water vapor or steam.

The CO_2 found by the Orsat, times the weight of 1 cubic foot, as before, .12267 times its specific heat, which is .217 times the difference in temperature between the room and the flue, will give the heat carried off by this gas.

The O and N are then treated in the same way, the O times .08921, times .21751 (its specific heat), times the difference in temperature between the room and flue and the N times .07831, times .2438 (its specific heat), times the same difference in temperature. The sum of the heat lost by the H_2O vapor, the CO_2, the O and the N will give the total B.T.U.'s carried off by the flue gases. And the B.T.U.'s lost in the flue gases divided by the total B.T.U.'s in the service gas proportional to the sample as found in paragraph 5 will give the percentage of heat lost in the flue.

FORMULÆ FOR DETERMINING THR TOTAL FLUE LOSS.

Let H = Wt. of H in one foot of service gas.
" C = " " C " " " " "
" CO_2 = Per cent. by volume of CO_2 in flue gas analysis.
" O = " " " " O " " "
" N = " " " " N " " "
" t = Temperature of the room.
" t' = " " flue.
" T = " at which water boils at that location.
" L = Latent heat of vaporization of water at that location.
" V = Calorific value of 1 foot of service gas at 32° 30 minutes.

$$\frac{(.1445292\,(t' + T) + 301104\,L + 301104\,(T - t)\,CO_2 + (.026619\,CO_2 + .0194\,O + .01909\,N)\,(t' - t)\,\frac{C}{H}}{\frac{.033456\,CO_2 V}{\frac{C}{H}}}$$

= per cent. of total heat in the gas, which is lost in the flue.

Flue Loss Due to Over-Ventilation.—In every gas appliance a certain amount of air must be admitted to support combustion, further, in every case more air is admitted than is theoretically necessary for this purpose. This air enters at the temperature of the room and leaves at the much higher temperature of the flue.

Suppose a case of 200 rise, which is common, and every pound of air will carry off about 47½ B. T. U's. of heat. This is the loss due to over-ventilation and the object is to determine what proportion this is of the total heat, which the gas was capable of developing. To make this determination it is necessary to know what proportion the service gas was to the sample of flue gas. That is, how much service gas was burned during the passage of a given sample of flue gas, and an analysis will not show this. A simple way of making this determination is illustrated in Fig. 11, entitled "Test for CO_2." The apparatus consists of a test meter, a Welsbach lamp without a mantle, and a gasometer of several cubic feet capacity. The gas is measured by the meter and burned in the lamp, the products of combustion being conveyed into the gasometer by suction through a pipe making close connection by a tin cone or funnel with the chimney of the lamp. A suction of about 3 inches is produced in the gasometer by balance weights and is then controlled by a cock in the flue pipe so that a natural flame is produced.

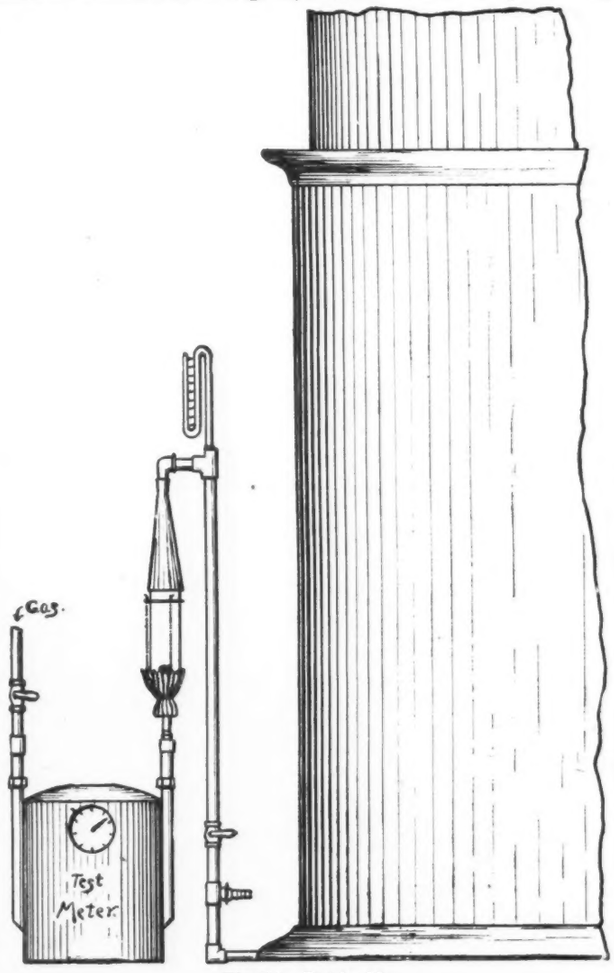

Fig. 11.—Test for CO_2.

The exact capacity of the gasometer should be determined by filling it with air drawn through the meter in the same way the flue gas is taken in and with the same suction to start and stop with that is used in the experiment. One and a half or 2 inches will be found convenient. The gasometer being filled with flue gas, or products of combustion, and its total capacity or cubical contents known, an analysis by an Orsat is made of a sample of the contents and the percentage of carbon dioxide determined, and from this is computed the total volume of CO_2 in the gasometer.

The meter will show the amount of gas used to make this quantity of CO_2 from which the amount of CO_2 formed by the combustion of 1 foot of service gas may be determined. Or this can be computed from an analysis of the service gas, but is not apt to be so accurate. This quantity will not usually vary materially from day to day, so that if accurate results are once obtained, they may be used until some change occurs in the service gas. The over-ventilation loss may be found.

With an Orsat apparatus the per cent. of carbon dioxide and oxygen in the flue gases is determined, for convenience assume these figures to

be cubic feet. The CO_2 is then divided by the amount of CO_2 found by the experiment to be formed by the combustion of 1 foot of service gas, which will give the number of feet of service gas proportional to a sample of 100 cubic feet of the flue gas, and this quantity multiplied by the calorific value of the service gas will give the total heat supplied during the passage of such a sample. The oxygen found by the analysts is then multiplied by .0926 a constant, and by the difference in temperature between the room and flue, which will give the total heat carried off by the excess air. The heat lost divided by the total heat supplied will give the per cent. of loss due to over ventilation.

To Determine Per Cent. of Over-Ventilation.—Loss not being considered, the per cent. of over-ventilation may be determined as follows: Make a flue gas analysis by volume with an Orsat for CO_2, O and by deduction N. In the proportion N : O :: 79.3 : 20.7 substitute the per cent. of N found by the analysis and solve for O. From this value for O deduct the value for O as found by the analysis, which was the free or excess O, and the result will be the O used for combustion. The free O divided by the O used will give the per cent. of over-ventilation.

The Gas Analysis with Orsat Apparatus.

The products of combustion from gas appliances may be readily analyzed by means of an Orsat apparatus, many modifications of which are on the market. A description of one type, however, will suffice. The method is to take a sample of known volume and, by bringing it successfully in contact with absorbents of the different constituent gases, determine by the volume remaining how much was removed in each case, and consequently the per cent. by volume of the different gases. The apparatus, illustrated in Fig. 12, consists of a measuring burette *A*

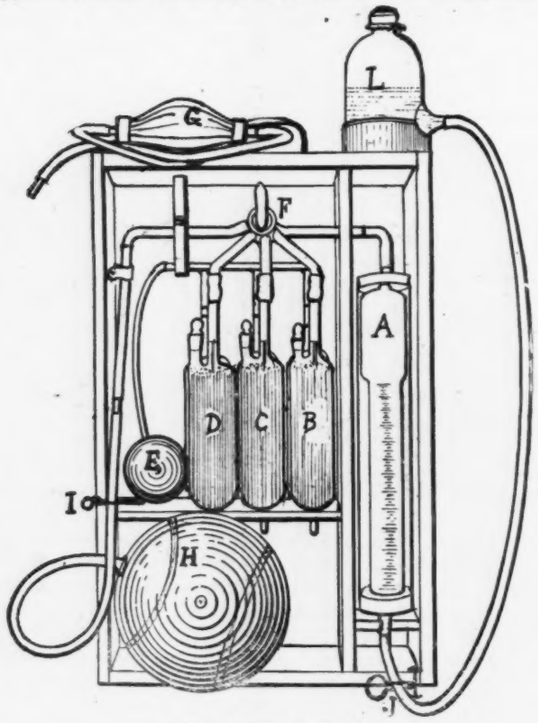

Fig. 12.—Orsat Apparatus.

with a capacity of 100 cubic centimeters, one end of which is contracted so that the graduations may be separated sufficiently to be legible to tenths of cubic cm., the whole scale extending through about 35 c.c. The burette is water jacketed so that the gas sample will readily reach the temperature of the room. A rubber hose makes connection between a leveling bottle, *L*, of about 200 c.c. capacity, and with a low side hose connection as shown, and the lower end of the burette. This bottle is about ¾ filled with water containing some salt, and by raising or lowering it gas is forced from or drawn into the burette by the water. The reagents are contained in 3 double bulbs, *B*, *C* and *D*, the bottoms of which connect with similar bulbs directly behind. The top ends of the front bulbs connect by capillary glass tubes and a 5-way cock with the burette, and another tube is arranged by which the sample of gas may be drawn in or expelled. The top ends of the back bulbs connect with a small bag *E*, which at first is filled with air. The object is to use the same air to fill the back bulbs each time the reagents are drawn into the front bulbs; in this way the oxygen is soon removed from the small bag, leaving only nitrogen (a neutral gas) in contact with the absorbents, thus prolonging their life. For collecting the gas sample, an aspirator, *G*, and a rubber bag, *H*, with a short length of hose attached, are convenient. The sample of gas is taken from near the center of the flue and close to the appliance, to avoid errors from infiltration of air at the joints, and is forced into the sample bag by means of the aspiratar, a pinch cock, *I*, being used to retain the gas. The bag should be deflated by rolling it up and again inflated several times before a sample is retained to insure one free from the former contents of the bag. The best means of procuring the flue gas sample is to use 2 gas pillars, with the lava tips removed, one placed inside, the other outside the flue pipe, a close nipple connecting them through a well-fitting hole in the pipe, so that they clamp it tightly. The absorbing reagents are as follows:

For carbon dioxide: Bulb *B;* a 16 per cent. solution of caustic potash (KOH) made by dissolving 16 grams in 84 c.c. of distilled water. For oxygen: Bulb *C;* an alkaline solution of pyrogallic acid ($C_6H_3(OH)_3$). Dissolve 20 grams of pyrogallic acid in 100 c.c. of water. When about to use mix some of this solution with its own volume of the potash solution. For carbon monoxide: Bulb *D*; a strongly acid solution of cuprous chloride. Dissolve 15 grams of the red oxide of copper (Cu_2O) in 100 c.c. of strong hydrochloric acid, specific gravity, 1.19. Keep this solution in a glass stoppered bottle with scraps of metallic copper, and keep pieces of clean copper wire in the absorption bulb with it.

The reagents are applied in the order given, the analysis being conducted as follows: The reagents are drawn up to the marks on the capillary tubes above the bulbs, then all the air is expelled from the burette by raising the leveling bottle and filling with water to the mark on the capillary above it. Then the sample bag is attached and the burette filled with gas by lowering the bottle, *L*. This sample is expelled, the bag being disconnected, as it contains the former contents of the long capillary tube and connections, and a new sample is drawn into the burette, filling it to about ¼ inch below the zero on the scale. The cock *F* is then closed and the sample allowed to reach the temperature of the burette, which is, of course, the same as the room. Set the leveling bottle on top of the case as shown, and pinch the cock *J* sufficiently to compress the gas in the burette slightly, then open the cock *F* to the air and carefully admit enough more water, by means of the pinch cock *J*, to raise its level exactly to zero, then at once close *F*, when the burette will contain exactly 100 c.c. of the flue gas at atmospheric pressure and the temperature of the room, so that any change of volume may be assumed to be caused by the action of the reagents. The 5-way cock *F*, is then turned to the KOH bulb *B*, and all the gas forced into it by raising the leveling bottle, being careful that no water follows the gas over. After a few minutes lower the bottle and draw the gas back until the KOH reaches the mark on the capillary. Repeat this 2 or 3 times and then take a reading with the leveling bottle held so that the water level in it is the same as in the burette with the pinch cock *J* open and *F* closed. Force the gas once more into *B* and let it stand, then bring it back and if the reading is the same as at first observing, say 10, it indicates that 10 c. c. of CO_2 were absorbed and, therefore, the sample contained 10 per cent. of CO_2. If the reading differed from the first, repeat until the reading become constant. Then the remainder of the gas is forced into bulbs *C* and *D*, successively in exactly the same manner, except that as O and CO are more difficult of absorption than CO_2 more time must be allowed the gas in contact with the absorbents. After bringing the gas out of the cuprous chloride solution bulb *D*, always pass it once or twice into the KOH bulb *B*, before taking a reading to remove gas evolved there.

If we obtain readings of 7, 15, 19 successively, it indicates that the sample of gas contained 7 per cent. CO_2, 15.7–8 per cent. O, 19.15 = 4 per cent. CO. The rest is nitrogen, 100 — 19 = 81 per cent N.

These results are in per cent. by volume, and if the per cent. by weight is required, multiply the per cent. by volume of the constituent gases by their respective densities, and divide each product by the sum of all the products. These densities may be taken as follows: Air being 1, CO_2 is 1.520; CO is .967; O, 1.105; N, .970.

Light and Illumination.—No. I.

[A paper read before the New York Section, December meeting, Illuminating Engineering Society, by Dr. Charles P. Steinmetz.]

Compared with other branches of engineering, as the transformation of electrical power into mechanical power in the electric motor, or the transformation of chemical into mechanical energy in the steam engine, we are at a disadvantage when dealing with light and illumination, because we have not to do strictly with a problem of physics, but are on the borderland between applied physics—that is, engineering and physiology. Light is not a physical quantity, but is the physiological effect exerted on the human eye by certain radiations. There are different forms of energy, all convertible into each other, as magnetic energy,

electric energy, heat energy, mechanical momentum, radiant energy, etc. The latter, radiant energy, is a vibratory motion of a hypothetical medium, the ether, which vibration is transmitted or propagated at a velocity something like 186,000 miles per second. It is a transverse vibration, differing from the vibratory energy of sound in this respect, that the sound waves are longitudinal—that is, the vibration is in the direction of the beam, while the vibration of radiation is transverse. Radiant energy can be derived from other forms of energy, for instance, from heat energy, by raising a body to a high temperature. Then the heat energy is converted into radiation and issues from the heated body, as, for instance, an incandescent lamp filament, as a group of radiations of different wave lengths—*i. e.*, different frequencies. All frequencies appear from very low frequencies, that is, only a few millions of cycles per second, up to many times higher frequencies. If desired, much lower frequencies in electro-magnetic waves may be produced, such as the radiations sent out by an oscillating or an alternating current; but the radiations which are given by heated bodies are all of extremely high frequency as compared with the customary frequencies of electric currents. At the same time they cover a very wide range of frequencies, many octaves, and from all this group of radiations, of all frequencies, somewhat less than 1 octave can be perceived by the human eye as light.

Light, therefore, is the physiological effect exerted upon the human eye by radiations within a certain narrow range of frequency. Frequencies lower than these, as well as those higher, are invisible. Those frequencies lower than the visible ones are called radiant heat. The higher ones are known as chemical rays. These terms, however, are misleading, and there is no distinction in character between radiations of different frequency. There are no heat rays differing from light rays or chemical rays. Any form of energy when destroyed gives rise to an exactly equivalent amount of some other form of energy. If, therefore, radiant energy is destroyed by intercepting the beam by interposing an opaque body in its path, then the energy of radiation is converted into some other form of energy, usually into heat. Any radiation when absorbed produces heat, and the amount of heat produced merely represents the amount of energy which was contained in the radiation. If the radiation contains a very large amount of energy, the heat developed by intercepting it may be sufficient to be felt by putting the hand in the beam. If the amount of energy is less, it may not be possible to feel it, though with a sensitive instrument, such as a bolometer, it may be possible to measure the heat. All radiations, therefore are convertible into heat, the visible light waves as well as the invisible ultraviolet rays, and the usually more powerful long infrared rays; but none of the radiations can be called heat, any more than the mechanical momemtum of a flywheel is heat, because, when destroyed, it produces heat.

Considering the infinite range of radiation issuing from heated bodies, it is found those rays which are of frequency lower than the visible rays will be felt as heat, because they contain a large amount of energy. The rays which are visible represent very little energy, and therefore they do not give as much heat. For instance, in the case of a hot steam boiler, although it sends out no light, the radiation from it can be felt by the heat which it produces when intercepted by the hand held near it. The radiation which issues as green light from the mercury cannot be felt as heat merely because the energy of this radiation is less than the amount of energy in the radiation from a hot boiler; but, while it is less, it happens to be of that frequency which affects the eye and is visible. It results from this that when one speaks of cold light, it is not meant that it is different from hot light; from the light, for instance, given by a hot coal fire, where the radiation is felt as heat; it merely means that what is usually called cold light, as, for instance, the light of the firefly is radiation containing to a very large extent rays of the visible frequencies and not much energy outside of the visible range; *i. e.*, containing very little total energy, so that the energy when converted into heat cannot be felt easily, but requires more delicate methods of determination. On the other hand, a very inefficient light, as a coal fire for instance, which gives most of its energy as invisible radiations of low frequency, and very little as visible, can be felt by the heat produced by the interception of the rays, which are mainly the energetic low frequency rays. As stated, there is no essential difference between so-called heat waves and light waves, but any radiation can be converted into other forms of energy, the so-called chemical rays of ultraviolet light, the x-ray, as well as infra red and the visible rays, and when converted into heat can be detected as such. Now it just happens that most of the available means of producing radiant energy give high intensities of radiation for low frequencies only, the invisible infra red rays, but it is not now possible to produce anywhere near the same intensity of radiation as higher frequencies.

So, also, when speaking of ultraviolet, or high frequency radiations, such as chemical rays, that does not mean they have a distinctive character in producing chemical action. Any form of energy can be converted, if one knows how, into chemical energy; the long ultra red waves just as well as the short ultraviolet waves. It just happens that those chemical compounds which are easily split up by radiant energy, such as silver salts or salts of gold and platinum, are especially affected by the ultraviolet and violet rays. For this reason, the chemical action of these rays is more noticeable than the other rays. There may, however, be some feature in the constitution of matter, which accounts for the high chemical action of the ultra-violet and violet rays. It is obvious if the radiations are intercepted and destroyed and their energy converted into other forms of energy, if the energy is only high enough, a high temperature results, and so high chemical action is produced by the mere effect of temperature. But there may be a chemical effect by what probably is some kind of resonance phenomenon. The particles of a body, atoms or molecules, must have some rate of vibration of their own. If, then, a ray of radiation impinges upon them which is of a frequency of the same magnitude as the inherent rate of vibration of the atom, by resonance this vibration of the atom must rapidly increase in intensity until the atom breaks away from the others, or the molecule breaks up; that is, the chemical combination is split up. The inherent frequency of oscillation of the atom seems to be about of the same magnitude as the visible radiations, or rather a little higher; that is, if the atoms are left to vibrate freely, as under the influence of an electric current in the arc, then radiations of the frequency inherent to the atom are given off. The general tendency is toward the violet or short wave end of the spectrum. If one assumes that the mass of the silver atom is such as to give a rate of vibration in the range of the violet and ultraviolet, it is easy to understand that a radiation of this frequency will split up the silver salt by increasing the vibration of the atom through resonance, and that shorter or longer waves will have no effect, or one much less. So it may be a mere incident that those chemical compounds on which the chemical action of radiation is marked just happen to be sensitive to the violet end of the spectrum. It is indeed a fact that other chemical changes are brought about by radiant energy, as the formation of ozone from oxygen, which is the splitting up of the oxygen molecule and the forming of the ozone molecule from the atoms and does not take place in the violet or ultraviolet, but requires frequencies much higher, about the highest frequencies which the mercury arc gives at low temperature. Possibly, since the oxygen atom is so much lighter than the silver atom, its frequency of vibration is much higher; which means that resonance effects and destruction of the molecules take place only with a much shorter wave length of radiation.

Inversely, it seems that those frequencies which are chemically active in organic life, which give the energy absorbed from radiation by plants and bring about the chemical activity utilized in building up the growth of vegetation, are at the red end of the spectrum, not at the violet end. It appears that the red and infra red rays produce growth of plants and the chemical activity called life, while the violet and ultraviolet rays kill. Even this can be understood if the chemical activity is considered as a resonance phenomenon, because the metabolism of protoplasm, which is called life, is based on the existence of unstable structures of carbon compounds. Here it is not atoms which are combining with each other, but groups, chain and ring formations, which are of larger mass and therefore have a lower rate of vibration, and so should be expected to respond to lower frequencies or to red light, as indeed seems to be the case. The violet and ultraviolet lights do not split up the organic matter into groups, which recombine to form complex bodies, and so represent the changes called life; but due to their higher frequencies, resonance occurs with the atoms, and the organic compound splits up into atoms and so disintegrates, which means death.

Thus it can be understood that the chemical activity of different radiations may be different, the chemical activity of long rays give life to vegetation and the short waves death; one splits the compounds up into carbon groups and the other carries destruction down to the atom.

Thus, the popular distinction between heat waves, chemical waves, light waves, is not a physical distinction, as all are radiant energy of the same character and differ merely in wave length. The visible range is somewhat less than 1 octave rather at the upper end, at the higher frequencies which are difficult to produce.

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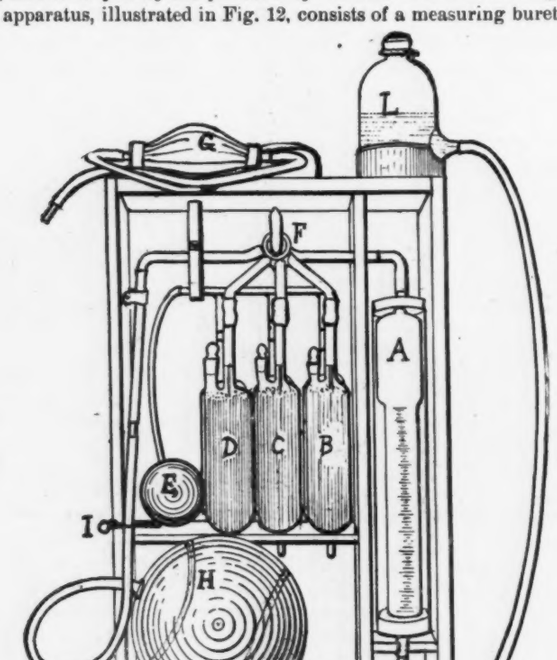
The Gas Analysis with Orsat Apparatus.

The products of combustion from gas appliances may be readily analyzed by means of an Orsat apparatus, many modifications of which are on the market. A description of one type, however, will suffice. The method is to take a sample of known volume and, by bringing it successfully in contact with absorbents of the different constituent gases, determine by the volume remaining how much was removed in each case, and consequently the per cent. by volume of the different gases. The apparatus, illustrated in Fig. 12, consists of a measuring burette *A*



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If we obtain readings of 7, 15, 19 successively, it indicates that the sample of gas contained 7 per cent. CO_2, 15.7–8 per cent. O, 19.15 = 4 per cent. CO. The rest is nitrogen, 100 — 19 = 81 per cent N.

These results are in per cent. by volume, and if the per cent. by weight is required, multiply the per cent. by volume of the constituent gases by their respective densities, and divide each product by the sum of all the products. These densities may be taken as follows: Air being 1, CO_2 is 1.520; CO is .967; O, 1.105; N, .970.

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[A paper read before the New York Section, December meeting, Illuminating Engineering Society, by Dr. Charles P. Steinmetz.]

Compared with other branches of engineering, as the transformation of electrical power into mechanical power in the electric motor, or the transformation of chemical into mechanical energy in the steam engine, we are at a disadvantage when dealing with light and illumination, because we have not to do strictly with a problem of physics, but are on the borderland between applied physics—that is, engineering and physiology. Light is not a physical quantity, but is the physiological effect exerted on the human eye by certain radiations. There are different forms of energy, all convertible into each other, as magnetic energy,

electric energy, heat energy, mechanical momentum, radiant energy, etc. The latter, radiant energy, is a vibratory motion of a hypothetical medium, the ether, which vibration is transmitted or propagated at a velocity something like 186,000 miles per second. It is a transverse vibration, differing from the vibratory energy of sound in this respect, that the sound waves are longitudinal—that is, the vibration is in the direction of the beam, while the vibration of radiation is transverse. Radiant energy can be derived from other forms of energy, for instance, from heat energy, by raising a body to a high temperature. Then the heat energy is converted into radiation and issues from the heated body, as, for instance, an incandescent lamp filament, as a group of radiations of different wave lengths—*i. e.*, different frequencies. All frequencies appear from very low frequencies, that is, only a few millions of cycles per second, up to many times higher frequencies. If desired, much lower frequencies in electro-magnetic waves may be produced, such as the radiations sent out by an oscillating or an alternating current; but the radiations which are given by heated bodies are all of extremely high frequency as compared with the customary frequencies of electric currents. At the same time they cover a very wide range of frequencies, many octaves, and from all this group of radiations, of all frequencies, somewhat less than 1 octave can be perceived by the human eye as light.

Light, therefore, is the physiological effect exerted upon the human eye by radiations within a certain narrow range of frequency. Frequencies lower than these, as well as those higher, are invisible. Those frequencies lower than the visible ones are called radiant heat. The higher ones are known as chemical rays. These terms, however, are misleading, and there is no distinction in character between radiations of different frequency. There are no heat rays differing from light rays or chemical rays. Any form of energy when destroyed gives rise to an exactly equivalent amount of some other form of energy. If, therefore, radiant energy is destroyed by intercepting the beam by interposing an opaque body in its path, then the energy of radiation is converted into some other form of energy, usually into heat. Any radiation when absorbed produces heat, and the amount of heat produced merely represents the amount of energy which was contained in the radiation. If the radiation contains a very large amount of energy, the heat developed by intercepting it may be sufficient to be felt by putting the hand in the beam. If the amount of energy is less, it may not be possible to feel it, though with a sensitive instrument, such as a bolometer, it may be possible to measure the heat. All radiations, therefore are convertible into heat, the visible light waves as well as the invisible ultraviolet rays, and the usually more powerful long infrared rays; but none of the radiations can be called heat, any more than the mechanical momemtum of a flywheel is heat, because, when destroyed, it produces heat.

Considering the infinite range of radiation issuing from heated bodies, it is found those rays which are of frequency lower than the visible rays will be felt as heat, because they contain a large amount of energy. The rays which are visible represent very little energy, and therefore they do not give as much heat. For instance, in the case of a hot steam boiler, although it sends out no light, the radiation from it can be felt by the heat which it produces when intercepted by the hand held near it. The radiation which issues as green light from the mercury cannot be felt as heat merely because the energy of this radiation is less than the amount of energy in the radiation from a hot boiler; but, while it is less, it happens to be of that frequency which affects the eye and is visible. It results from this that when one speaks of cold light, it is not meant that it is different from hot light; from the light, for instance, given by a hot coal fire, where the radiation is felt as heat; it merely means that what is usually called cold light, as, for instance, the light of the firefly is radiation containing to a very large extent rays of the visible frequencies and not much energy outside of the visible range; *i. e.*, containing very little total energy, so that the energy when converted into heat cannot be felt easily, but requires more delicate methods of determination. On the other hand, a very inefficient light, as a coal fire for instance, which gives most of its energy as invisible radiations of low frequency, and very little as visible, can be felt by the heat produced by the interception of the rays, which are mainly the energetic low frequency rays. As stated, there is no essential difference between so-called heat waves and light waves, but any radiation can be converted into other forms of energy, the so-called chemical rays of ultraviolet light, the x-ray, as well as infra red and the visible rays, and when converted into heat can be detected as such. Now it just happens that most of the available means of producing radiant energy give high intensities of radiation for low frequencies only, the invisible infra red rays, but it is not now possible to produce anywhere near the same intensity of radiation as higher frequencies.

So, also, when speaking of ultraviolet, or high frequency radiations, such as chemical rays, that does not mean they have a distinctive character in producing chemical action. Any form of energy can be converted, if one knows how, into chemical energy; the long ultra red waves just as well as the short ultraviolet waves. It just happens that those chemical compounds which are easily split up by radiant energy, such as silver salts or salts of gold and platinum, are especially affected by the ultraviolet and violet rays. For this reason, the chemical action of these rays is more noticeable than the other rays. There may, however, be some feature in the constitution of matter, which accounts for the high chemical action of the ultra-violet and violet rays. It is obvious if the radiations are intercepted and destroyed and their energy converted into other forms of energy, if the energy is only high enough, a high temperature results, and so high chemical action is produced by the mere effect of temperature. But there may be a chemical effect by what probably is some kind of resonance phenomenon. The particles of a body, atoms or molecules, must have some rate of vibration of their own. If, then, a ray of radiation impinges upon them which is of a frequency of the same magnitude as the inherent rate of vibration of the atom, by resonance this vibration of the atom must rapidly increase in intensity until the atom breaks away from the others, or the molecule breaks up; that is, the chemical combination is split up. The inherent frequency of oscillation of the atom seems to be about of the same magnitude as the visible radiations, or rather a little higher; that is, if the atoms are left to vibrate freely, as under the influence of an electric current in the arc, then radiations of the frequency inherent to the atom are given off. The general tendency is toward the violet or short wave end of the spectrum. If one assumes that the mass of the silver atom is such as to give a rate of vibration in the range of the violet and ultraviolet, it is easy to understand that a radiation of this frequency will split up the silver salt by increasing the vibration of the atom through resonance, and that shorter or longer waves will have no effect, or one much less. So it may be a mere incident that those chemical compounds on which the chemical action of radiation is marked just happen to be sensitive to the violet end of the spectrum. It is indeed a fact that other chemical changes are brought about by radiant energy, as the formation of ozone from oxygen, which is the splitting up of the oxygen molecule and the forming of the ozone molecule from the atoms and does not take place in the violet or ultraviolet, but requires frequencies much higher, about the highest frequencies which the mercury arc gives at low temperature. Possibly, since the oxygen atom is so much lighter than the silver atom, its frequency of vibration is much higher; which means that resonance effects and destruction of the molecules take place only with a much shorter wave length of radiation.

Inversely, it seems that those frequencies which are chemically active in organic life, which give the energy absorbed from radiation by plants and bring about the chemical activity utilized in building up the growth of vegetation, are at the red end of the spectrum, not at the violet end. It appears that the red and infra red rays produce growth of plants and the chemical activity called life, while the violet and ultraviolet rays kill. Even this can be understood if the chemical activity is considered as a resonance phenomenon, because the metabolism of protoplasm, which is called life, is based on the existence of unstable structures of carbon compounds. Here it is not atoms which are combining with each other, but groups, chain and ring formations, which are of larger mass and therefore have a lower rate of vibration, and so should be expected to respond to lower frequencies or to red light, as indeed seems to be the case. The violet and ultraviolet lights do not split up the organic matter into groups, which recombine to form complex bodies, and so represent the changes called life; but due to their higher frequencies, resonance occurs with the atoms, and the organic compound splits up into atoms and so disintegrates, which means death.

Thus it can be understood that the chemical activity of different radiations may be different, the chemical activity of long rays give life to vegetation and the short waves death; one splits the compounds up into carbon groups and the other carries destruction down to the atom.

Thus, the popular distinction between heat waves, chemical waves, light waves, is not a physical distinction, as all are radiant energy of the same character and differ merely in wave length. The visible range is somewhat less than 1 octave rather at the upper end, at the higher frequencies which are difficult to produce.

The problem of investigating and dealing with light is difficult for the engineer, because it is not a physical quantity which can be meas-

ured accurately, as in the case of power or velocity, but it is a physiological effect. The total energy of radiation from a heated body may, indeed, be measured very accurately, but the total energy of radiation is not light; only a very small part of it is visible. It is possible to go further and split up the total radiation issuing from a hot body, as from an incandescent lamp filament, into its different wave lengths of different frequencies, by resolving it into a spectrum by means of a prism, and then to collect all of the radiation within the visible range by a lens or other means and measure the energy of these radiations. Or, still simpler, some medium, such as glass or water, which absorbs the invisible long rays and invisible short rays, and which transmits all, or nearly all, of the visible rays, may be interposed in the beam of radiation.

In this manner the energy of the visible radiations may easily be measured and compared with the total energy radiated. That would give a physical measure of the efficiency of the process of producing visible radiation, but it would not be a measure of the efficiency of producing light, since unfortunately the different wave lengths of the visible radiation have very different physiological effects. A given amount of energy as visible radiation, giving the effect of green light, represents an entirely different amount of light and causes a much greater physiological effect than the same amount of energy in rays of the wave lengths which give the impression of red light.

It follows from this that the physiological effect, or light equivalent of mechanical energy within the visible range, is a function of the wave length and varies with the color. That really is obvious, because the energy radiated at low frequencies represents no light whatever and has no physiological equivalent; it is invisible. Coming to the visible range, if there is a physiological into the visible range the physiological equivalent must pass from effect, that is, light. Therefore, in passing from the invisible zero into a finite value, it must necessarily pass continuously. At the extreme end of the visible range, the light equivalent of energy must be extremely low, and the further one goes into the visible range, the greater it is. The maximum is reached in the middle of the visible range, in the green and yellow. Then it decreases down to zero at the violet end of the visible rays; beyond that, at still higher frequencies, the physiological equivalent of energy is zero also. Or, inversely, the mechanical equivalent of light is a minimum in the middle of the visible range where 1-candle power of light represents the lowest amount of energy, and increases towards the ends of the spectrum of the visible range, reaching infinity at the ends. In other words, the efficiency of light production is a function of the wave length, that is, of the color, and is at its maximum in the middle of the spectrum, where the same amount of power, measured in watts, gives the largest amount of light measured in candle power.

Unfortunately, the physiological equivalent of power, or the physiological effect of light, varies not only with the wave length, but also with the absolute intensity. If it be required to compare red, yellow and green lights, or any lights of different colors, great difficulties are met. Suppose 1-candle power is wanted in light as red, yellow, or green. The different colors cannot be compared directly, since there is no physical measure of light. Lights are compared with a standard lamp, which has a certain color, usually a yellowish white. Lights of the same color can be compared exactly. If the color is not much different, an approximate comparison may still be made; but with widely different colors not even an approximate comparison can be made. One cannot say when the two sides of the photometer screen, one illuminated by green light, the other by red light, are equal in intensity. Thus there can be no direct comparison of different colored lights. It is necessary to go one step farther and consider that light is used for illumination, is used to see by, and this gives a fair method of comparison; let it be observed at what distances from the two lights, red and green, there is the same ease in reading the same print; or, to measure more exactly, get the maximum distance at which a certain size of print can just be read by each light. At these distances the two illuminations are the same, and so the two lights have intensities inversely proportional to the squares of the distances. In this manner lights of different color can be compared.

Necessarily, the comparison has not the accuracy of a photometrical comparison. This cannot be expected, since physical quantities are not compared, but only physiological effects on the eye, and different observers may have different personal constants. The eye of the one may be more sensitive to green, and the eye of the other to red, and therefore the comparisons may be different. However, these individual differences are not great, and different observers, even with widely different colors of light, do not give results differing much from each other; so that a comparison of intensities of different colored lights, and thereby a measurement of the intensity of different colored lights in candle power, is feasible, by some such method.

It is found, however, with a green light and a red light, which at a certain distance appear equally brilliant to the eye, when approached the red light appears much brighter than the green, and receded from the green light appears brighter, and at greater distances the green light may still be fairly bright when the red light is almost invisible. That is, the relative physiological effect of different wave lengths varies, not only with the wave lengths, but also with the absolute intensity of illumination, and while throughout the whole range the sensitivity of the eye for green light is much greater than for red light, the difference is far greater for low than for high illuminations. That is, the ratio of sensitivity for green compared with that for red is greater for faint illuminations than for intense illuminations. If it be desired to express lights of different colors in candle power, it seems necessary also to give the distance, or the intensity of illumination at which the observations were made. In other words, the light from the middle and the short wave end of the spectrum gives a better and more efficient illumination when the total intensity of illumination is low than the long or low frequency rays of red, orange and yellow, but the latter colors give a much more brilliant effect at high intensities than the same amount of light of shorter wave length.

This is of importance for the illuminating engineer, because when it is desired to get high intensity effects, as in decorative lighting or in advertising, better results are given by the low frequency end of the spectrum, by orange and yellow light; whereas when a low intensity of illumination is satisfactory, as in street lighting, better results are given by the short wave end or the middle of the spectrum, by the greenish-yellow of the Welsbach gas lamp and the bluish green of the mercury lamp. Therefore the white light of the carbon arc gives better results in street lighting than the yellow of the incandescent lamp, even at equal intensity of illumination. These features have been of small importance until recent years, since the available sources of light were all approximately of the same color, varying from orange-yellow, to yellow and yellow-white, to white; from the orange-yellow color of the gas lamp, kerosene lamp and tallow candle to the yellow incandescent lamp, the yellowish white arc, the yellowish white sunlight, to the white diffused daylight. This was a fairly limited range. It is only in the last few years that illuminants of high efficiency have been brought out which give marked and decided color differences and are available in units of suitable size and of high efficiency; such, for example, are the greenish-yellow Welsbach gas lamp, the bluish green mercury lamp, and the orange-yellow flaming arc. Hence these questions of color are increasing in importance.

(To be Continued.)

Electrolysis of Gas Mains.

[By Mr. M. R. Bump, Denver, Col. Prepared for the American Gas Institute, on behalf of the Western Gas Association.]

In preparing this paper, on a subject that has been so extensively and exhaustively discussed before all of the gas and water associations for the past 15 years, it has been my aim to reduce to a compact form the various views on the subject which are now accepted by gas and water engineers. In addition, I have aimed to set forth certain facts that, to my knowledge at least, have not received the attention and discussion which they merit.

On the fundamental theory of the electrolytic cell much has already been written. The present theory of the electrolytic cell is the development of an hypothesis set forth by Clausius, in 1857. When a salt is dissolved in water, and the slightest electric current is passed through the solution, some of the molecules of the salt are broken up to form ions, which are atoms, or groups of atoms, which form the basic and acid components of the salt. The simplest example is common salt, which breaks up into two ions, one of which, the basic ion, is a single atom of sodium, the other is the acid ion and is a single atom of chlorine.

If an electric current is passed through a salt solution the basic or metallic ions become charged with a positive charge of electricity, and tend to move toward the negative electrode and discharge their electricity upon it. As soon as they are discharged, the ions become free chemical atoms and plate themselves upon the electrode as a metallic deposit, this action being commonly taken advantage of in the electroplating industry.

The acid ions in the solution become charged with a negative charge of electricity and tend to move toward the positive electrode of the cell and to discharge upon it. When discharged they likewise become chemically free and active, and if the electrode is a metal that forms a salt with the acid ions thus freed the electrode will be broken down to form that salt and will thus be carried off into the solution. It is this latter reaction that usually takes place when an iron pipe is corroded and destroyed by the acid ions in the earth surrounding the pipe.

The correctness of the theory of electrolytic action has recently been challenged by Dr. Louis Kahlenberg, who has gone very extensively into the chemistry of the subject and who presents a long list of arguments based on experiment that apparently disprove the theory. This makes little difference to the gas men, for, with the laws worked out, he can calculate the effect of the action and that is the point that he is interested in. There are two general laws which govern the amount of electrolytic action, and with these laws the effect can be determined for any particular case. These fundamental laws are as follows:

1. When an electric current is passed through an electrolyte, the quantity of the liquid decomposed; *e. g.*, the amount of electrolytic action, depends upon the amount of electricity, measured in coulombs, which passes through the electrolyte and is independent of the size of the electrode and of the electric pressure applied.

2. When equal quantities of electricity are passed through different electrolytes, equivalent quantities of the electrolytes are decomposed; *e. g.*, a coulomb of electricity will decompose a certain amount of a chloride solution and a different but equivalent amount of a sulphate solution, these amounts always bearing definite relation to each other.

The first law states that the amount of electrolytic action is independent of the pressure applied. Here is where many mistakes have been made by gas men who have expected to find the greatest electrolytic action where the voltmeter showed the greatest reading between the rail and the pipe. The customary pressure charts of our cities have, for this and other reasons, very little value except to define the bounds of the so-called "negative" area. The fact that the drop from the pipe to the rail is large indicates that the earth at that point is a very poor conductor of electricity and that the current flow between the two is small. Often the greatest amount of corrosion is found at points where the difference of potential is almost too small to determine, being only 1 or 2 milli-volts.

The first law also makes it plain that 1 ampere of current flowing from a pipe will destroy a certain definite amount of iron, whether the pipe is 2 inches or 60 inches in diameter, provided the pipe is in the same quality of earth.

The second law relating to quantities decomposed is stated in a reverse manner from that desired for use of gas men. A given quantity of electricity will decompose a certain amount of iron, if ferric or the higher salts are formed, and another definite amount if ferrous salts are formed, regardless of whether the electrolyte is a chloride sulphate or any other acid. Metals like iron that form 2 series of salts possess this quality. For others that form only 1 series of salts, there is always but 1 quantity decomposed by a given amount of electricity.

It has been generally supposed and accepted that damage to a pipe occurs only where current leaves the pipe, and in general this statement is practically correct. I am informed by Prof. Burgess it has been proven that, in some cases, current entering a pipe has caused an acceleration of the corroding action on the pipe. An explanation of this action may be found in the fact that pipes subject to the natural corroding influence of the surrounding earth become covered with a deposit that protects the pipe from further corrosion. When a current enters a pipe it may destroy the covering thus formed and leave the pipe subject to further corrosion from the surrounding earths.

All of us are familiar with the attempts made during past years to induce or force traction companies to adopt better return construction. First, better bonding was demanded and was in a measure obtained. Next, a system of return feeders to supplement the rail return was added, and still the troubles were not lessened materially. Some few cities tried to compel the traction companies to supply the double trolley system, but this has not proven a succees. Litigation has been said to have cost some companies more than the damage from electrolysis, but it would seem that it has availed little in forcing the needed relief. As a general rule those companies have fared best that have enlisted the co-operation of the traction companies in an endeavor to reduce the damage to the lowest possible point. Some traction companies have paid a portion of the cost of renewing pipes destroyed by electrolysis, but these cases are exceptional. While we have direct current traction, some other means must be found.

At the present time a new factor is entering into the problem and one that happily offers relief to a large degree from the damages caused by electrolysis. I refer to alternating current traction. This new system is giving to the electric traction industry a new impetus, which up to the present time has been confined largely to interurban and long distance lines, but which is destined to come into use in our large cities as soon as proven practicable on the longer lines, and there seems to be no reason to doubt the practicability of the system. It is a well-known and established fact that an alternating current does not cause electrolysis to nearly as great an extent as does direct current. In fact, it is often stated that the alternation of the direction of flow will entirely stop electrolytic action. On this point, however, there seems to be some question. In a thesis presented for a degree at the University of Wisconsin, a report is made of a series of tests to determine the amount of electrolytic corrosion caused by the ordinary 60-cycle alternating current, and the findings establish the facts that corrosion is accelerated by an alternating current, though the amount of action is very small compared with direct current electrolysis. It is possible that the increase in corrosion in this case is not due directly to electrolysis, but to the fact that the protecting scale does not form, as I have explained in the case of a direct current entering a pipe and causing increased corrosion. An extended series of tests would be necessary to decide upon the correct solution of this point.

In view of certain court decisions that the railway companies can be compelled to provide that system which is considered best modern practice, it would seem that the interest of gas companies should be enlisted in an endeavor to prove that the new system is the best modern practice, and I am confident that within 10 years it will be regarded as such.

Leaving the consideration of this matter, I wish to take up the question of protection of existing systems from direct current electrolysis. Gas men are apparently almost equally divided into two classes, each of which maintains that electrolysis is best prevented by their general system of protection. Broadly speaking these 2 classes are as follows:

1. Of that class which believes in bonding the pipes to the return circuit and cause as much of the current to leave through these bonds as possible.

2. Of that class which aims to make the pipes as poor conductors as possible, and thus prevent as far as possible all current from entering their pipes. In addition there are various combinations of the 2 general systems to be found. Taking up the first general class it is apparent that, if all current could be collected and kept on the pipe until removed through the bond, it would offer an ideal solution of the problem. The placing of bonds between the pipe and return circuit in the negative area, however, often not only does not help conditions but makes them much worse. The conductivity of the circuit through the pipe is increased greatly and as a result more current follows the pipe. With cast iron mains we find the greatest trouble caused by current jumping around the joints, and the greater the current flow in the pipe the greater becomes this tendency to jump the joints and, therefore, the greater is the damage to the system. This is especially true where cement joints are employed, and there seems to be hardly a case where bonding would be advisable when these joints are used. Even if the pipe were of uniform conductivity there would be a tendency for current to follow the pipe through earths of high resistance and leave it again when earths of better conductivity are encountered. In order to make an ideal of this system, it would be necessary to provide pipes the conductivity of which would at all times be so much greater than that of the surrounding earth that little current would tend to leave the pipe for other paths. This, however, is a physical impossibility, and the system offers at best little relief in the average case.

The other general system has as its ideal fulfillment a pipe that is a non-conductor. It aims to keep all current from following the pipe. From the gas man's standpoint it is the ideal system. When bonding is advocated by gas companies to remove current from their pipes, they partially at least concede the right of the traction companies to use their pipes as a return circuit. This weakens their position in case they take a claim for damages into the courts. The nearest approach to the ideal system is found in the extensive use of insulating joints to break the continuity of the pipes as return conductors, thus reducing the amount of current carried by the pipes to as small an amount as possible. The proper installation of insulating joints is a very im-

portant engineering problem, and one in which every case is a special problem involving quality of earth, moisture, etc., the aim in each case being to allow as little current as possible to jump around the joint. Of recent years the tendency to use wrought iron mains instead of cast iron has been spreading wonderfully. Without involving myself in a question as to the relative merits of the two, I wish to call attention to the statements of a manufacturer of insulating couplings and patent couplings extensively used for natural gas, to the effect that it is possible to lay wrought iron pipe with an insulating coupling every second joint at a less first cost than for screw pipe of the same size. This point is well-worth careful consideration by every gas manager. Considered from the standpoint of reduction in leakage, the shorter life wrought iron pipe is overcome by the reduction in lost and unaccounted-for gas as compared with cast iron pipe.

Electrolysis occurs when a current leaves a conductor through an electrolyte. In our case the pipe must be a conductor and the current leave through earths that are electrolytes. This points out 2 fundamental methods of curing our troubles: 1. Use pipes that are not conductors; 2, insulate all pipes from the surrounding earths by a protective covering.

Quite recently there has been announced in France the result of tests with paper gas mains that offer considerable promise. The mains in question were tested under 300 pounds pressure, then subjected to regular service in the ground for some time, and were pronounced as good as new when removed for inspection. I am informed that experiments along this line are being started in this country, but cannot secure any information as to the results obtained to date.

Some years ago the use of vitrified pipes was much agitated in this country. Climatic conditions seemed to preclude the possibility of using them in the northern sections. More recently English patents have been issued on a concrete pipe and system of installation. With the present activity in steel concrete construction, it would seem that there is considerable promise along these lines. The strength of the pipe could easily be designed to at least equal that of cast iron. Several experiments have been tried along this line, and I expect to see the matter presented in definite shape for the consideration of gas and water companies within a short time. It would make a report of the greatest importance.

The second essential in the prevention of electrolysis would seem to offer a most interesting field—the invention of a pipe covering that will protect the pipe and prevent current from leaving the pipe through an electrolyte. The prime factor in such a covering is that it must be moisture proof. If moisture proof it would of necessity be gas tight. Leakage could not occur. How much added investment could our companies make per mile of main to prevent leakage alone? Balance interest on investment against the cost of gas lost by leakage and the results will show what an expenditure would be justified from this point of view alone. The subject of coverings for mains and service pipes has been extensively investigated, but, so far as I know, no one has produced an entirely successful covering. Some recent experiments with a cement covering for pipe have shown that there is a great deal of merit in it if properly applied. Several different tar mixtures, such as the Hickenlooper, are in use for tarring service and small main pipes. That they are beneficial cannot be denied, but they are not efficient enough. Tarring and boxing service pipes has proven a decided success in some cities, and records show that they greatly increase the life of the service and decrease the leakage. Boxed pipes show very little deterioration from corrosion, and to my mind this process offers the best protection in use at the present time, and there seems to be an increasing popularity for this method of protection. Attempts are being made to devise a covering that can be moulded on the pipe at a low first cost. Forcing jacks are coming very extensively into use and an extremely strong casing would be required if the pipes were to be forced Such a covering would have many advantages and would be a very excellent thing.

The whole subject of electrolysis as applied to any case should be studied with one fundamental law in view, namely: "Prevent all current from leaving the pipes through an electrolyte." The nearer we can approach to this condition the better will conditions become. The interests of the gas fraternity are at present directed largely to the following features of the problem, and future advances toward a solution of the problem may be expected from them. These features are:

1. The introduction of alternating current traction in our cities.
2. The development of a satisfactory protective covering.
3. The development of a new class of electrolysis proof pipe.
4. The industrious application of the fundamental rule to existing systems and conditions.

[The paper closes with an appendix entitled "Bibliography of Papers and Notes on Electrolysis," appearing in American and English gas journals, 1901–1905, inclusive. In it are 29 references.—EDS. A. G. L. J.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE United States Government has been appealed to by navigators to place gas lighted buoys for marking the Canadian channel, between Belle Isle and Peche Island. The course is now designated by two wooden buoys of antiquated type.

THE San Antonio (Tex.) Gas and Electric Light Company will extend its main system to Laurel Heights.

THE offices of the Illuminating Engineering Society have been removed to No. 25 West 39th street, New York, from 4 Irving Place. All communications to the Secretary, Dr Arthur H. Elliott, should be so addressed.

"DEAR JOURNAL: I suppose you know all about the refusal of the City Council of Philadelphia to confer inquisitorial authority upon the Mayor's late Gas Commission. Shortly, this was a proposition to combine with the Council Committee of six to the Municipal Governmental Committee. Mr. Brown, of the First Ward, in a very clever speech, during the discussion, remarked that, if the whole truth were known, two things would be well proved. First, that the city did not want the gas works; if it did, it did not have the money to pay for them. On another thought, we cannot help believing that the Mayor, having named his Commissioners, turned to the U. G. I. Company in the hope the latter would, by careful training, transform them into gas experts, that they might intelligently direct their acts. The Mayor had to divide the interest with two other things, the refusing to let Major Gillette, of the Filtration Bureau, sit as one of the Consulting Board in New York; the other, referring the entire filtration litigation to arbitration. I do not think it makes much difference to the Major, for before leaving the army he thoughtfully bonded himself by requiring from certain gentlemen a guarantee of $15,000 for 5 years; so, no matter where he goes, the $15,000 goes on, like the brook in the poem. Of course, you know about the Council's latest scheme for taking back the gas works. For mine, I would gladly divide my half of the profit (?) with the U. G. I. to run the works. As it stands now, it is not stated who is to run them—whether the Mayor or the people! The whole thing sounds like the old rhyme, 'When the devil was sick,' etc. At a period when the gas could hardly be transported (or emitted) through the pipes—only as far back as 1896 at that—the U. G. I. was a glorious thief; now it is an inglorious thief!—J * * * ."

THE City Council, of Tyler, Tex., has granted to Mr. John H. Fitzgerald, of Palestine, Tex., and his associates, a franchise to construct and operate a gas plant in Tyler for a term of 50 years. Tyler is the seat of Smith county, the bottoms of which are known for their productiveness, and its population, now numbering $12,000, is growing in rapid way. The "Cotton Belt" Railroad has its general offices and main shops in Tyler, and the International and Great Northern Railroad passes through it. Mr. Fitzgerald is the gentleman who knows thoroughly how to fix up Tyler's gaseous needs.

THE Union Carbide Company has determined to construct a factory for the manufacture of calcic carbide at Sault Ste Marie, Mich.

WE are indebted to Messrs. Theo. Audel & Co., 63 Fifth avenue, New York, for a copy of the fifth revised edition of "Self-Propelled Vehicles," the well known work by James E. Homan, M.D., on all forms of automobiles. Every autoist should have a copy handy of this excellent practical treatise.

ON and after July 1st next the net rate for gas will rule at $1.15 per 1,000 cublic feet in Madison, Wis.

MR. THOMAS M. EYNON, "retained as an expert member of the Commission to examine into the accounts of the United Gas Improvement Company with the city of Philadelphia," has handed in his bill, which was forthwith "hung-up" by the City Controller. The expert worked 22 days at $50 per.

AT the annual meeting of the shareholders in the Providence (R. I.) Gas Company, no change was made in the executive management. The annual report of the President, who knows vastly more about the manufacture of gas than he did 4 years ago, showed that the quantity of gas made in the year 1906 was 1,072,763,000 cubic feet, showing an increase amounting to 9 per cent. over the output for the preceding twelvemonth. The weights of coal used were: Bituminous, 22,287 tons; anthracite, 15,787; quantities of oil, 3,573,428 gallons; coke, 36,387 bushels. Quantities of residuals sold: Coke, 45,223 bushels;

coal tar, 250,960 gallons; ammoniacal liquor, 954,135. The distributing system was added to by the placing of 30,947 feet of 6-inch pipe; and 958 services were laid. The number of meters in use totaled 35,923, an increase of 2,285 for the year. There are 39,984 consumers on the books, and a concession of 5 cents per 1,000 in the selling rate goes into effect April 1st. The capital stock was increased by the issuing of 5,000 new shares, bringing the total up to $3,500,000. Foundations for the new works at Sassafras Point will be constructed this year.

MR. DUNCAN CAMPBELL, who recently resigned the position of Business Manager of the Grand Rapids (Mich) Gas Light Company, to accept a like position with the Scranton (Pa.) Company, is busily at work in his new field. We understand that Mr. Glen R. Chamberlain will add to his duties as Secretary of the Grand Rapids Company those of Business Manager as well.

AT the annual meeting of the New Amsterdam (N. Y.) Gas Company, Mr. Percy R. Pyne, 2d, was elected a Director, vice the late Mr. Emanuel Lehman.

AT a meeting of the Directors of the Fall River (Mass.) Gas Works Company, held the first week this March, a resolution was passed authorizing the distribution of a dividend of 10 per cent. on the wages of the employees, earned the past twelvemonth. The executive officers did not participate in the distribution, and the amount involved by this voluntary act is very close to $5,000.

THE Federal Gas and Fuel Company, of Columbus, O., has been obliged to exact that hereafter tenants must make a deposit sufficient to insure the payment of their gas bills for 2 months. Such deposits to carry 5 per cent. per annum interest. If the landlords guarantee the payment of the bills no deposit will be looked for.

THE Western United Gas and Electric Company, of Aurora, Ills., is arranging to extend its main system to and through Lemont.

THE Evansville (Ind,) Gas and Electric Company will extend its main system into the suburban district known as Oakdale.

THE proprietors of the projected gas plant for Merrill, Wis., say that the works will be completed by August 1st, and that the plans so far made call for an expenditure of approximately $100,000.

MR. R. B. SEARS has resigned from the service of the Sacramento (Cal.) Gas and Electric Company to conduct a well-known hotel establishment in Vallejo, Cal.

EX-MAYOR POWELL, of Fort Worth, Tex., is blowing hot and cold (chiefly the latter) over his pet scheme of the operation on public account of the local gas works.

SOME weeks ago we reported the arguments advanced by the Laclede Gas Light Company, of St. Louis, Mo., in the suit brought before Judge Fisher for a permanent injunction restraining the Gas Consumers' Association from installing pressure regulators at certain points on the house services of the Company. The judge took the case under advisement and recently handed down his decision making the injunction permanent. We hope to shortly print the text of the opinion.

WE understand that the Richmond (Ind.) Light, Heat and Power Company has been purchased by the New York syndicate, of which Mr. Henry Wilson is the official head.

THE owners of the Savannah (Ga.) Electric Company have determined to fix up a suitable show room for the display of its wares, etc. Mention is made of this merely to declare that it is to be modelled after the show rooms now operated by the Columbus (Ga.) Gas Light Company.

"R. G. W.," writing from Stockton, Cal., under date of the 5th inst., incloses the following: "Ordinance No. 439, empowering the City Council of Stockton to fix rates charged by corporations for gas and electricity for light and heat has been adopted. In pursuance of the provisions of the measure the Council also adopted a resolution calling on the gas and electric companies to furnish tabulated statements of all parties using gas and electricity and the amount paid by each during the past year. These statements must be furnished during the month of March. The Council will pass an ordinance in April fixing the rates for the ensuing year."

THE Pitman, Glassboro and Clayton Gas Company, of Pitman, N. J., have obtained the right from the Glassboro Camp Meeting Association to bury gas mains in the Grove. Nearly all the houses in the Grove are piped for gas, the supply being of the Springfield automatic machine type.

THE Granite City (Mo.) Gas Light and Fuel Company will forthwith expend $20,000 on its plant on Railroad avenue and Twenty-second street.

THE Union Gas and Electric Company, of Cincinnati, O., has placed an order with the Gas Bench Construction Company, of St. Louis, Mo., for the complete material for resetting 30 benches of 6's at its East End Station.

THE authorities of La Crescent, Minn., on the opposite side of the river to La Crosse, Wis., are anxious to have a gas works and the voters of the place have ratified by their ballots a proposition looking to that end. Mr. F. G. Potter, of La Crescent Council, has the matter in charge.

MR. F. L. EATON has, as General Manager, assumed active charge of the business of the Gainesville (Tex.) Light and Fuel Company.

THE shareholders of the Consumers Gas Company have voted to accept an amendment to its charter, which specifies "That said corporation is formed for the purpose of manufacturing and supplying gas for light and fuel to the public of the city of Johnstown, boroughs of Dale, East Conemaugh, Franklin and Westmont and the townships of West Taylor, East Taylor, Upper Yoder and Conemaugh, all contiguous territory in the county of Cambria, Pa.

DR. DAVID FISHER, Chemist for State of Wisconsin, has notified Mr. A. S. Mitchell, Gas Inspector for Milwaukee, Wis., that the standard for the heating value of gas, as adjusted by him, is to rule at 600 B.T.U.'s.

THE Board of Supervisors for San Francisco will proclaim the following as the rates that shall prevail there in respect of a gas and electric supply on public account for the ensuing year: Gas per 1,000 cubic feet, 85 cents; public lamps, gas, 8.70 cents each per night; gas, public lights, cluster type, 15 cents each per night. Electric service: Current, per 1,000 kilowatt hours, 9 cents; arc electrics, burning 24 hours, $5 each per week; electric arc lights, from sunrise to sunset, $3 each per week; ditto, sunrise to sunset, $2.25 each. Current supplied by meter carries a minimum of $1 per month.

WORK on the new office building for the Louisville (Ky.) Gas Company, which is to be located at the junction of Fourth and Chestnut streets, will be commenced forthwith. The cost of the structure and its equipment will approximate to $100,000.

AT the annual meeting of the shareholders in the Macon (Ga.) Gas Light and Water Company a dividend of 2 per cent. on the first preferred stock of the Company was declared. The officers elected were: President, H. T. Powell; Treasurer, Stuart Wood; Secretary, W. C. Solomon; Directors, the officers and A. E. Boardman, W. H. Felton, Jr., Philip Jennings, Stuart Wood, Walter Wood and W. G. Solomon. Mr. A. C. Blinn was continued as General Manager.

AT the annual meeting of the Paterson and Passaic (N. J.) Gas and Electric Company the officers elected were: Directors, E. T. Bell, Lewis Lillie, Walton Clark, B. W. Spencer, John Reynolds, W. B. Gourley, Hobart Tuttle, Randal Morgan, F. K. McCully, John W. Ferguson and W. F. Douthirt.

MR. JOHN DAVEY, formerly in charge of the power plant of the Marquette (Mich.) County Gas and Electric Company, has been appointed Master Mechanic of the Pennsylvania and Western Railroad Company.

WITH exceeding satisfaction we report the convalescence of Mr. J. O. Johnston, President and General Manager of the Columbus (O.) Gas and Fuel Company.

MESSRS. E. M. SINCLAIR and A. C. Berry are proposing to establish a gas plant in Bridgewater, Ia.

THE State Commission of Gas, Water and Electricity have postponed the taking of testimony relative to the gas supply of Buffalo, N. Y., to the first Tuesday of April. Lucky it was that they could avoid naming the first Monday of April as the appointed time.

THE proprietors of the Long Island Gas Company have withdrawn their petition to the Connecticut Legislature under which they sought the right to supply gas in Milford, Conn., now that the New Haven Company proposes to extend its mains thereto.

MR. JOHN A. BRITTON, General Manager of the San Francisco Gas and Electric Company, is responsible for the statement that the total receipts from all sales of gas for 1906 were $1,889,824.04, as against $2,528,905.81 for the year previous, which meant a falling off in the income of the Company of about $639000. Mr. Britton further said that the loss was due, first, to the reduction in gas rates ordered by the Supervisors, and also to the loss of business caused by the disaster of last April. The average price obtained for gas during the year was 89.9 cents per 1,000 cubic feet, as against 99 cents the year previous.

MR. ELLSWORTH FRANCISCO, the official inspector of gas and meters for Newark, N. J., is "rather anxious to know" when the local authorities will let him enjoy that peace which comes to those who have a permanent domicile. They "moved" three times since the spring of 1904.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
No. 42 Pine Street, New York.
Telephone, 2996 John.

TERMS:

SUBSCRIPTION—Three Dollars per annum, in advance.
Single copies, 10 cents.

The JOURNAL is the official organ of the
NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

NOTIFICATION RESPECTING ADVERTISING.

Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

AGENTS:

New York—American News Co., 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, MARCH 18, 1907.

The Market for Gas Securities.

Who can write without putting down words of amazement respecting the gas share market! What has Congress or its action to do with values in Consolidated gas? Nevertheless we are called upon to report a net loss in that stock of 13 points for the week. And to make it worse, the low point this morning (Friday) was 110; at 11 the shares were "restored" to 115. This is the lowest point touched by it in 20 years, and the Company in reality never was stronger, better equipped or wealthier. *Tout pour rire.* And Brooklyn Union at 109!

Think of it, too; Peoples, of Chicago, at 86! Why not quote Washington at 150? The figures tell the story of the "bear storm," or the "jack" flight. The United Gas Improvement Company has declared the regular quarterly dividend of 2 per cent.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

MARCH 18.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	114½	115
Central Union Gas Co.—				
1st 5's, due 1972, J. & J.	3,000,000	1,000	101	104
Equitable Gas Light Co.—				
Con. 5's, due 1932, M. & S.	1,000,000	1,000	..	105
Mutual	3,500,000	100	190	235
New Amsterdam Gas Co.—				
1st Con. 5's, due 1948, J. & J.	11,000 000	1,000	98½	100
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	37	43
1st Mtg. Gold Bds. 5 p.ct.	1,000,000	.	98	104
Northern Union—				
1st 5's, due 1927, J. & J.	1,250,000	1,000	101	103
New York and East River—				
1st 5's, due 1944, J. & J.	3,500,000	1,000	108	111
Con 5's, due 1945, J. & J.	1,500,000	..	104	110
Standard	5,000,000	100	140	160
Preferred	5,000,000	100	155	175
1st Mtg. 5's, due 1930, M. & N	1,500,000	1,000	104	108
The Brooklyn Union	15,000,000	1,000	108	115
1st Con. 5's, due 1948, M. & N	15,000,000		107	..
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Bay State	50,000,000	50	¼	⅜
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	..	65
" 1st Mtg. 5's	509,000	1,000	95	100
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000.000	1.000	47½	50
Buffalo City Gas Co.	5,500,000	100	9	10
" " Bonds, 5's	5,250,000	1,000	75	80
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1.000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,500,000	1,000	104	106¾
Cincinnati Gas and Electric Co.	29,500,000	100	99	99½
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	90	..
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	..	95
Preferred	3,096,500	100	107½	108
Consumers, Toronto	2,300,000	50	200	204
Consolidated, Baltimore	11,000,000	100	.	90
Mortgage, 6's	3,500,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N. J.	1,000,000	100	15	17
Con. Mtg. 5's	880,000	1,000	92	95
Bonds	75,000	..	..	100
Detroit City Gas Co	5,000,000	50	..	50
" Prior Lien 5's	4,618,000	1,000	..	98
Detroit Gas Co., 5's	381,000	1,000	75	80
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,500	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	..	110	112
Bonds, 5's	10,500,000	..	107½	108½
Indianapolis	2,000,000	..	60	70
" Bonds, 5's	2,550,000	..	104½	105
Jackson Gas Co	250,000	50	82	..
" 1st Mtg. 5's	290,000	1,000	97	100
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	16
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	..	05
Preferred	2,500,000	100	95	110
Bonds	10,000,000	1,000	104	104½
Lafayette Gas Co., Ind.	1,000,000	100	..	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	143	145
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	106	108½
" 6 per cent. scrip, due 1910	100,000	25	85	87
Massachusetts Gas Companies of Boston	25,000,000	100	56	56¼
Preferred	25,000,000	100	81	84¼
Montreal, Canada	2,000,000	100	218	218½
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co.	6,000,000	..	56	58
Bonds, 6's	6,000,000	..	137	138
New Haven	2,000,000	25	200	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	85	86¼
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
" 2d "	2,500,000	1,000	104	..
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	104½	105½
San Francisco, Cal.	15,800,000	100	..	..
St. Joseph Gas Co. 1st Mtg. 5's	751,000	1,000	92	..
St. Paul Gas Light Co	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,465,000	1,000	96¾	..
Syracuse, N. Y.	1,975,000	100	50	55
Bonds	2,047 000	1,000	102	..
Washington, D. C	2,600,000	20	292½	30
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	..	..	..
Wilmington, Del.	600.000	50	230	

Advertisers' Index.

GAS ENGINEERS.

	Page
A. E. Boardman, New York City	465
Baxter & Young, Detroit, Mich	475
B. E. Chollar, St. Louis, Mo	468
Cruse-Kemper Co., Philadelphia, Pa	464
Davis & Farnum Mfg. Co., Waltham, Mass	476
Economical Gas Apparatus Construc'n Co., Toronto, Ont	475
Frank D. Moses, Trenton, N. J	476
Fred. Bredel Co., Milwaukee, Wis	474
Frederic Egner, Norfolk, Va	480
H. M. Byllesby & Co., Chicago, Ills	463
Humphreys & Glasgow, New York City	476
Isbell-Porter Co., Newark, N J	464
J. F. W. Jost, Philadelphia, Pa	480
Kerr Murray Mfg. Co., Fort Wayne, Ind	477
The Gas Machinery Co., Cleveland, O	460
The Jeffrey Manufacturing Co., Columbus, O	474
United Gas Improvement Co., Philadelphia, Pa	471
Western Gas Construction Co., Fort Wayne, Ind	484

GAS WORKS APPARATUS AND CONSTRUCTION.

A. E. Boardman, New York City	465
Bartlett, Hayward & Co., Baltimore, Md	477
Baxter & Young, Detroit, Mich	475
Connelly Iron Sponge & Governor Co., New York City	473
Continental Iron Works, Brooklyn, N. Y	478
Cruse-Kemper Co., Philadelphia, Pa	464
Davis & Farnum Mfg. Co., Waltham, Mass	476
Deily & Fowler, Philadelphia, Pa	480
Economical Gas Apparatus Construc'n Co., Toronto, Ont	475
Frank D. Moses, Trenton, N. J	476
Fred. Bredel Co., Milwaukee, Wis	474
Humphreys & Glasgow, New York City	476
Isbell-Porter Company, New York City	464
Kerr Murray Mfg. Co., Fort Wayne, Ind	477
Lloyd Construction Co., Detroit, Mich	466
Logan Iron Works, Brooklyn, N. Y	480
Quintard Iron Works, New York City	476
R. D. Wood & Co., Philadelphia, Pa	478
Riter-Conley Mfg. Co., Pittsburgh, Pa	479
Stacey Mfg. Co., Cincinnati, O	479
The Gas Machinery Co., Cleveland, O	460
The Jeffrey Manufacturing Co., Columbus, O	474
United Gas Improvement Co., Philadelphia, Pa	471
Western Gas Construction Co., Fort Wayne, Ind	484

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md	477
B. E. Chollar, St. Louis, Mo	468
Economical Gas Apparatus Construc'n Co, Toronto, Ont	475
Fred. Bredel Co., Milwaukee, Wis	474
Humphreys & Glasgow, New York City	476
Semet-Solvay Co., Syracuse, N. Y	474
The Gas Machinery Co., Cleveland, O	460
United Gas Improvement Co., Philadelphia, Pa	471
Western Gas Construction Co., Fort Wayne, Ind	484

SCRUBBERS AND CONDENSERS.

Continental Iron Works, Brooklyn, N. Y	478
Cruse-Kemper Co., Philadelphia, Pa	464
Davis & Farnum Mfg. Co., Waltham, Mass	476
Economical Gas Apparatus Construc'n Co., Toronto, Ont	475
Fred. Bredel Co., Milwaukee, Wis	474
Isbell-Porter Co., Newark, N. J	464
Kerr Murray Mfg. Co., Fort Wayne, Ind	477
Logan Iron Works, Brooklyn, N. Y	480
R. D. Wood & Co., Philadelphia, Pa	478
Riter-Conley Mfg. Co., Pittsburgh, Pa	479
Stacey Mfg. Co., Cincinnati, O	479
The Gas Machinery Co., Cleveland, O	460
Western Gas Construction Co., Fort Wayne, Ind	484

PRODUCER POWER PLANTS.

Economical Gas Apparatus Construc'n Co., Toronto, Ont	475
R. D. Wood & Co., Philadelphia, Pa	478

TAR AND CARBONIC ACID EXTRACTOR.

Economical Gas Apparatus Construc'n Co., Toronto, Ont	475
Fred. Bredel Co., Milwaukee, Wis	474
Isbell-Porter Co., Newark, N. J	464
Kerr Murray Mfg. Co., Fort Wayne, Ind	477
Stacey Mfg. Co., Cincinnati, O	479
The Gas Machinery Co., Cleveland, O	460
Western Gas Construction Co., Fort Wayne, Ind	484

AMMONIA CONCENTRATORS.

Fred. Bredel Co., Milwaukee, Wis	474
Kerr Murray Mfg. Co., Fort Wayne, Ind	477
Michigan Ammonia Works, Detroit, Mich	466
The Gas Machinery Co., Cleveland, O	460
Western Gas Construction Co., Fort Wayne, Ind	484

GAS METERS.

American Meter Co., New York and Philadelphia. 483
Detroit Meter Company, Detroit, Mich..... 483
D. McDonald & Co., Albany, N. Y..... 481
Helme & McIlhenny, Philadelphia, Pa..... 483
John J. Griffin & Co., Philadelphia, Pa..... 440
Keystone Meter Co., Royersford, Pa..... 482
Maryland Meter and Mfg. Co., Baltimore, Md..... 482
Metric Metal Co., Erie, Pa..... 483
Nathaniel Tufts Meter Co., Boston, Mass..... 482
New York Improved Meter Co., New York City 482
Pittsburg Meter Co., East Pittsburg, Pa 481
Rotary Meter Co., New York City..... 459

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia..... 483
D. McDonald & Co., Albany, N. Y..... 481
Helme & McIlhenny, Philadelphia, Pa..... 483
John J. Griffin & Co., Philadelphia, Pa..... 440
Keystone Meter Co., Royersford, Pa..... 482
Nathaniel Tufts Meter Co., Boston, Mass..... 482
New York Improved Meter Co., New York City..... 482
Pittsburg Meter Co., East Pittsburg, Pa..... 481

PREPAYMENT METER ATTACHMENTS.

New York Improved Meter Co., New York City 482
Reeves Mfg. Co., New Haven, Conn..... 469

WATER METERS.

Pittsburg Meter Co., East Pittsburg, Pa..... 481

GAS AND WATER PIPES.

Davis & Farnum Mfg. Co., Waltham, Mass..... 466
Donaldson Iron Co., Emaus, Pa..... 468
Economical Gas Apparatus Construc'n Co., Toronto, Ont. 475
R. D. Wood & Co., Philadelphia, Pa..... 478
Warren Foundry and Machine Co., New York City..... 468

GAS COALS.

Berwind-White Coal Mining Co., New York and Phila. 474
Perkins Co., New York City..... 474
Westmoreland Gas Coal Co., Philadelphia, Pa..... 475

SPECIALTIES FOR OIL AND PIPE LINES.

S. R. Dresser, Bradford, Pa..... 462

GAS MAIN STOPPERS.

Safety Gas Main Stopper Co., New York City..... 468

MAIN AND SERVICE LAYING.

Sullivan Bros., Flushing, N. Y..... 458

GAS TAPPING MACHINES.

George Light, Dayton, O..... 469
H. Mueller Manufacturing Co., Decatur, Ills..... 461

CANNEL COALS.

Perkins & Co., New York City..... 474

STOKING MACHINERY.

G. A. Bronder, New York City..... 471

CONVEYORS.

Cruse-Kemper Co., Philadelphia, Pa..... 464
C. W. Hunt Company, New York City..... 465
Economical Gas Apparatus Construc'n Co., Toronto, Ont 475
Fred. Bredel Co., Milwaukee, Wis..... 474
G. A. Bronder, New York City..... 473
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 477
The Gas Machinery Co., Cleveland, O..... 460
The Jeffrey Manufacturing Co., Columbus, O..... 474
Western Gas Construction Co., Fort Wayne, Ind..... 484

(*Continued on page 458.*)

DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO.,
N. W. CORNER BROAD AND ARCH STS.,
PHILADELPHIA, PA., Mar. 13, 1907.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable April 15th, 1907, to stockholders of record at the close of business, Mar. 31, 1907. Checks will be mailed.

16 8-4 LEWIS LILLIE, Treasurer.

Estimates furnished for the erection of complete gas works or the extension and modernizing of old works. All work warranted. Both water gas and coal gas.

EMPIRE GAS IMPROVEMENT & CONSTRUCTION COMPANY,
1628-tf 49 Wall Street, New York.

Position Wanted

As Manager or Superintendent of a Gas Company,

By a young man who has had 10 years of practical experience in the manufacture and distribution of coal and water gas. Also good accountant. Best of references furnished. Address, "BOX 133,"
1658-1 Care this Journal.

Position Wanted

By a Practical, All Round Gas Man, as Superintendent of a Coal or Water Gas Plant

Having a daily capacity of from 100,000 to 1,000,000 cubic feet. First-class references.

1657-4 Address, "E. P. J.," care this Journal.

Position Wanted.

A Capable Manager and Superintendent,

Now employed, desires a position as manager or superintendent of gas, or combined gas and electric plants, in city of 15,000 to 25,000 population. Successful record. Southern or Middle States location preferred.

Address, "P. T. A.,"
1641-tf Care this Journal.

Position Wanted

AS A GAS MAKER

(Now Employed in a Large Plant)

By a young man with 10 years' practical experience (water gas); can run engine and familiar in everything where steam is used; has solicited, read meters, laid pipes and put up gas stoves; can do mostly anything around small plant.
1657-2 Address, "GENERATOR," care this Journal.

WANTED,

A Practical Working Superintendent,

Who understands the manufacture and distribution of coal gas. State salary and experience. CHICKASHA GAS CO.,
1657-2 CHICKASHA, I. T.

Position Wanted

As Manager of Gas Company in City of 35,000 to 50,000 Population.

Young man, thoroughly experienced in all branches of the business, desires to change position to go with a progressive company. Highest references.
1656-3 Address, BOX 132, care this Journal

Position Wanted.

Young man, experienced in gas, electric and heating business, capable of holding position of manager, auditor, purchasing agent or superintendent of new business, desires to change position.
1658-1 Address, "P. P. P.," care this Journal.

Situation Wanted.

Young man, 30 years of age, and of 12 years' practical experience in gas manufacture and distribution, wishes situation as engineer or superintendent of a gas company where expert services are required and the output is at least 50,000 per day. Is graduate engineer and at present superintendent of one of the largest high pressure plants in the U. S. The best of references and experience only.
1658-1 Address, "S R. U.," care this Journal.

WANTED,

Position as Superintendent of Gas Company,

By young married man of 16 years' experience in all its branches. Is now superintendent of gas company of 30,000,000 cubic feet. Will have to give present company 60 days' notice. Best of references.
1652-tf Address, "CAPABLE," care this Journal.

WANTED,

A Thoroughly Experienced Erector for Water Gas Apparatus.

Must have best references.
1658-1 Address, "A.," care this Journal.

WANTED,

A Practical Gas Superintendent,

One who understands water gas, to take charge of works in town situated 20 miles from New York.
1658-1 Address, "N. S. L., 129," care this Journal.

WANTED,

AN AGENT IN EVERY STATE,

To introduce as a side line to gas companies and others the Ackroyd True Radiator, which does everything other gas heaters fail to do. A quick seller. The only satisfactory heater on the market. Write for particulars.

THE ACKROYD RADIATOR CO.,
1656-4 PLAINFIELD, N. J.

WANTED,

Superintendent and Manager of Gas and Electric Light Plant in New England.

Give experience, age, and salary required, to
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Stacey Mfg. Co., Cincinnati, O. 479

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Standard Oil Co., New York City, 475
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Fred. Bredel Co., Milwaukee, Wis. 474
The Jeffrey Manufacturing Co., Columbus, O. 474

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H. Mueller Manufacturing Co., Decatur, Ills. 463

GAS COCKS.

H. Mueller Manufacturing Co., Decatur, Ills. 463

GAS GAUGES.

The Bristol Co., Waterbury, Conn. 465

GAS GOVERNORS.

Chaplin-Fulton Mfg. Co., Pittsburgh, Pa. 468
Connelly Iron Sponge & Governor Co., New York City. 473
Fred. Bredel Co., Milwaukee, Wis. 474
Isbell-Porter Co., Newark, N. J. 464
Pittsburg Meter Co., East Pittsburg, Pa. 481
. D. Wood & Co., Philadelphia, Pa. 478
Reynolds Gas Regulator Co., Anderson, Ind. 472

FUEL ECONOMIZERS.

Green Fuel Economizer Co., Matteawan, N. Y. 465

CEMENTS.

C. L. Gerould, Pittsburgh, Pa. 472

RETORTS AND FIREBRICKS.

Baltimore Retort and Firebrick Co., Baltimore, Md. 472
Gas Bench Construction Co., St. Louis, Mo. 474
Henry Maurer & Son, New York City 465
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J. H. Gautier & Co., Jersey City, N. J. 472
Laclede Firebrick Mfg Co., St. Louis, Mo. 473
Missouri Firebrick Co., St. Louis, Mo. 472
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Fred. Bredel Co., Milwaukee, Wis. 474
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Kerr Murray Mfg. Co., Fort Wayne, Ind. 477
Logan Iron Works, Brooklyn, N. Y. 480
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Isbell-Porter Co., Newark, N. J. 464
Kerr Murray Mfg. Co., Fort Wayne, Ind. 477
R. D. Wood & Co., Philadelphia, Pa. 478
Stacey Mfg. Co., Cincinnati, O. 479
Western Gas Construction Co., Fort Wayne, Ind. 484

PURIFYING MATERIALS.

Connelly Iron Sponge & Governor Co., New York City. 473

VALVES.

Continental Iron Works, Brooklyn, N. Y. 478
Davis & Farnum Mfg. Co., Waltham, Mass. 476
Economical Gas Apparatus Construc'n Co, Toronto, Ont 475
Isbell-Porter Co., Newark, N. J. 464
Kerr Murray Mfg. Co., Fort Wayne, Ind. 477
Ludlow Valve Manufacturing Co., Troy, N. Y. 465
R. D. Wood & Co., Philadelphia, Pa. 478
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The P. H. & F. M. Roots Co., Connersville, Ind. 467
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John Cabot, Hoboken, N. J. 475
Western Gas Construction Co., Fort Wayne, Ind. 484

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American Meter Co., New York and Philadelphia 483
Keystone Meter Co., Royersford, Pa. 482
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Nathaniel Tufts Meter Co., Boston, Mass. 483

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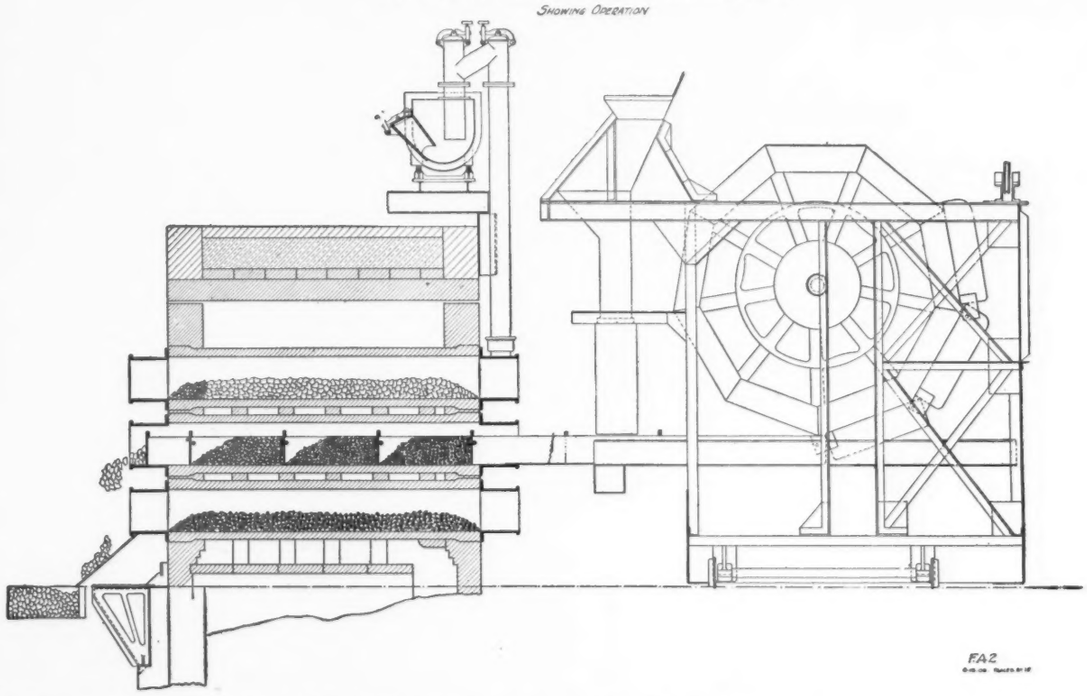

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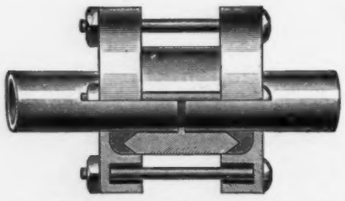
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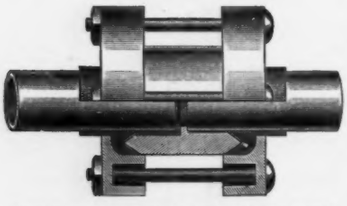
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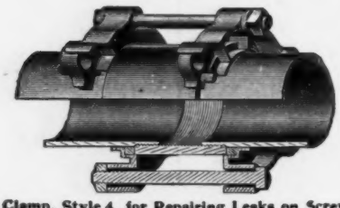
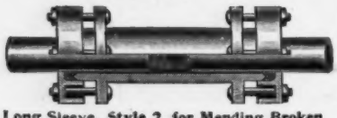

Clamp, Style 4, for Repairing Leaks on Screw Collar.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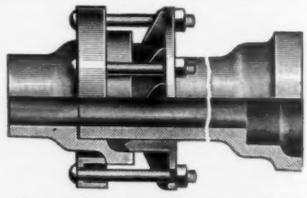
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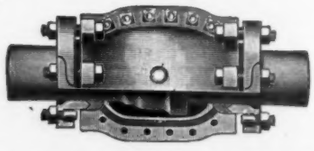
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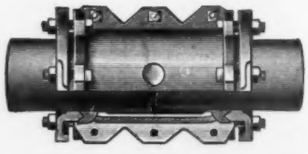
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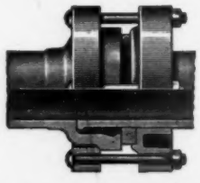
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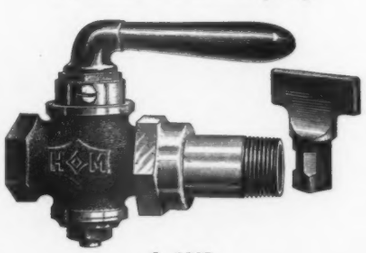

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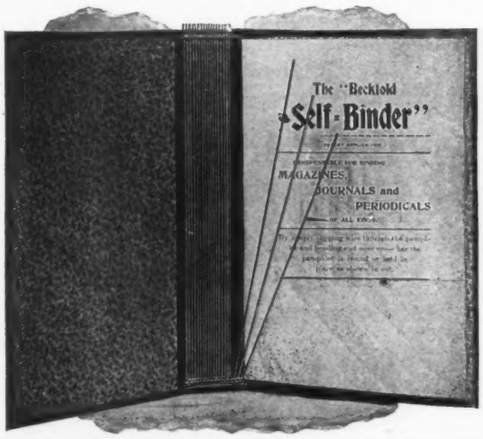

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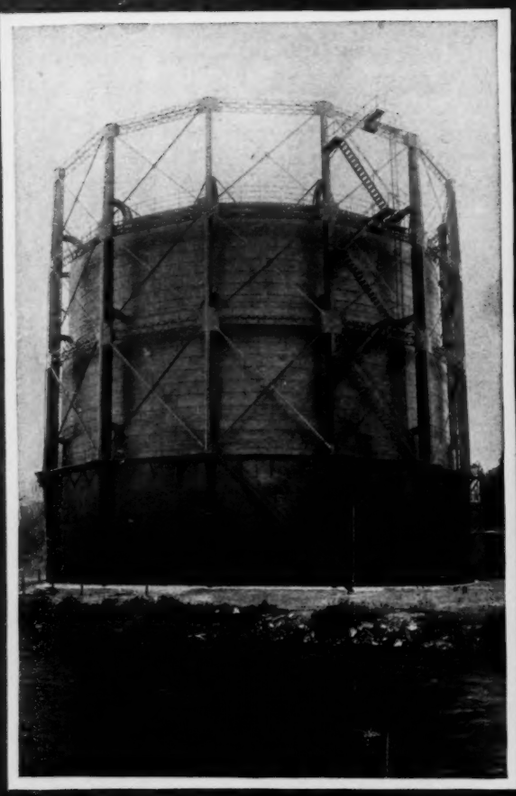

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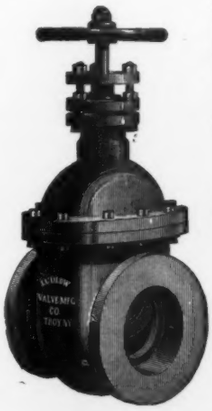

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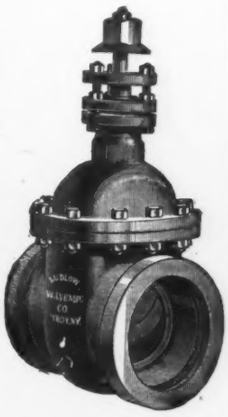

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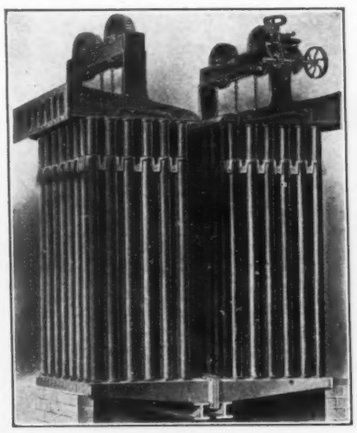
Manufacturers of

High Grade Firebrick, Blocks, Tiles,

ETC.,

Works: Maurer, N. J. Office: 420 E. 23d St., N. Y. City.



HOW MUCH COAL PER 1,000 CU. FT. OF WATER GAS?

If the process of making water gas were theoretically perfect, only 24 lbs. of coal would be consumed per 1,000 cu. ft. of gas generated. As a matter of fact, the actual figures are between 40 and 48 lbs. per 1,000 cu. ft. It is apparent that there is a waste somewhere, and if you will take the trouble to put a thermometer over the stack valve during the "blowing up" period, you will see where the heat goes to. From one-third to one-half of the heat escapes to the atmosphere, either as sensible heat or latent heat of combustion. If use can be found for this heat a great economy could be effected immediately.

We have found such a use. By means of the Green Air Heater 12 per cent. to 15 per cent. of this heat, or more, can be imparted to the air blown to the generator. This will reduce the time for blowing up and increase the temperature of the generator, so that about the same proportion of coal will be saved.

After the gases have passed through the air heater they are still hot enough to use in a Green Fuel Economizer to heat the boiler-feed water up to the evaporative point. In In this way a quarter of the boiler coal can be saved. In connection with a 6-ft. generator an investment of $3,500 in an Air Heater and an Economizer will save from $2,300 to $2,500 per year. This ought to repay you for the trouble of writing us for further information. Ask for Circular "AG."

THE GREEN FUEL ECONOMIZER CO.,

MATTEAWAN, N. Y.

(Sole builders of the Green Fuel Economizer in this country; we also build Fans and Blowers.)

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And for every other Hot Water Need, use the

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HUMPHREY CRESCENT INSTANTANEOUS WATER HEATERS.

Efficient. Compact. Durable. Every Heater Guaranteed.

No. Heaters.	Price.	Gas Supply from Meter.	Heats Gals. per Min. 50° in Temperature.	Height.	Diameter.	Shipping Weight.
Non-Contact.. 2	$40.00	¾ Inch.	2½	34⅝ Inches.	12 Inches.	70 Pounds.
Contact..... 6	29.00	¾ "	3	29⅛ "	12 "	60 "
" 8	23.50	1 "	2½	28⅜ "	10¼ "	48 "

These prices include Safety Valves and Unions, one Bent Output Spout. For prices of fittings see our complete catalogue, "The Luxury of a Bath."

We will be glad to quote Discounts.

HUMPHREY CO., · · · Kalamazoo, Mich.

The ONLY manufacturers in the world of a complete line of Instantaneous Water Heaters.

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Maximum Efficiency,
Minimum Back Pressure,
Complete Safety.

Western Sales Agent
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AND HIGH PRESSURE GAS PUMPS BUILT BY

THE CONNERSVILLE BLOWER CO.

Stand so High in the estimation of those using them?

THE ANSWER IS IN THREE WORDS:

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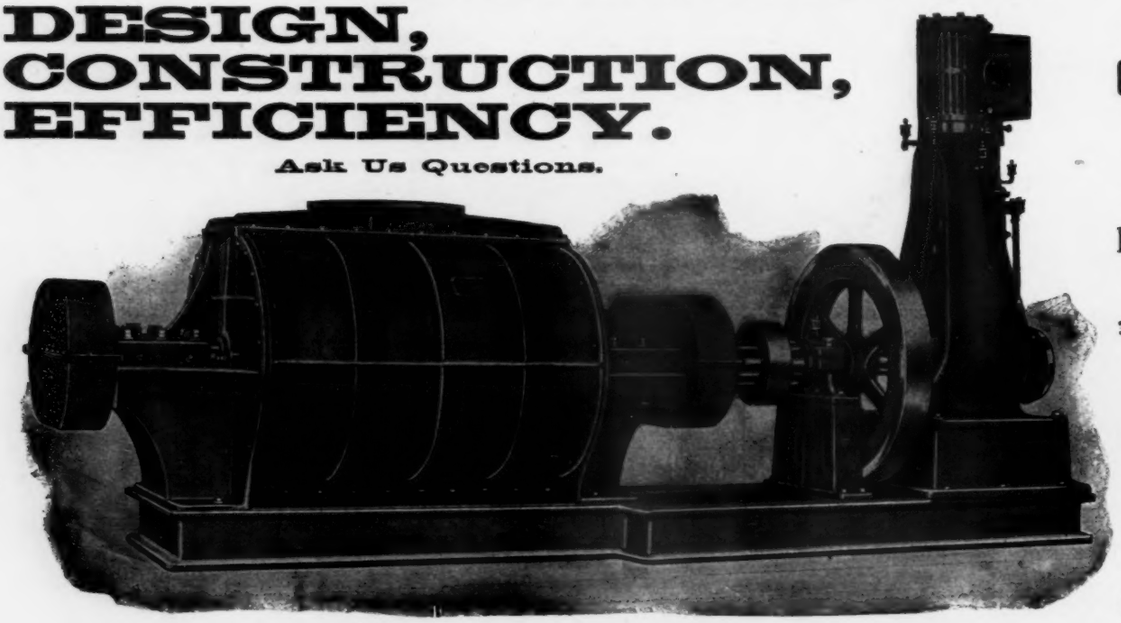

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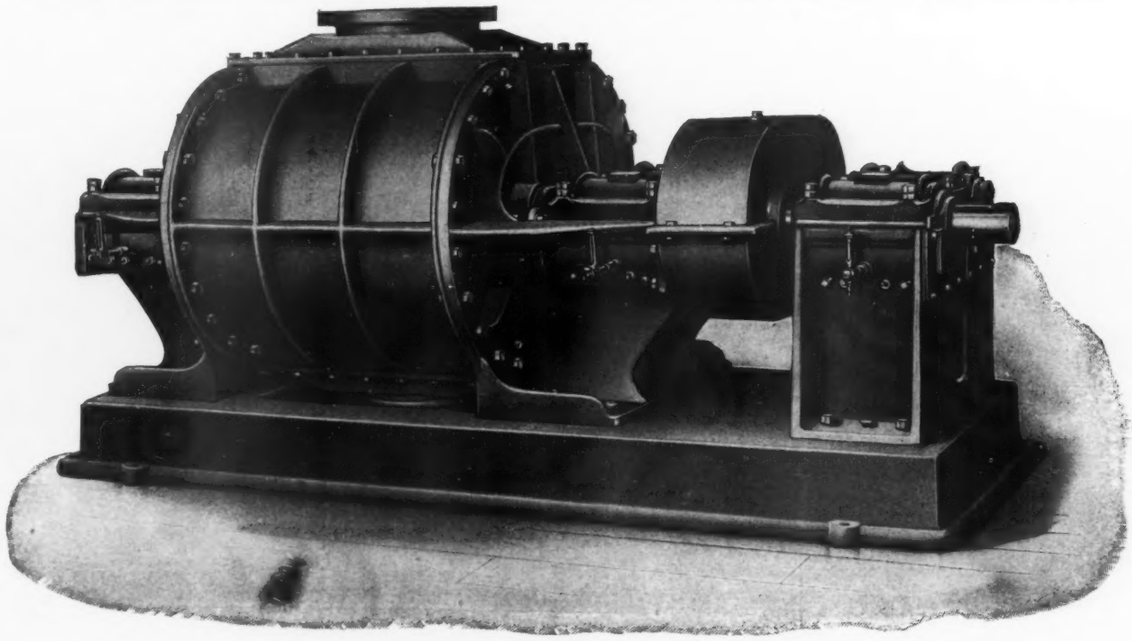
ROOTS' EXHAUSTERS for HIGH and LOW PRESSURE WORK.

The highest efficiencies obtained. Most perfect devices for adjustment and maintenance of proper alignment. Use our flexible coupling to correct troubles caused by misalignment and engine shaft thrust. Our gas governor is the best. By-pass, gas valves and fittings.



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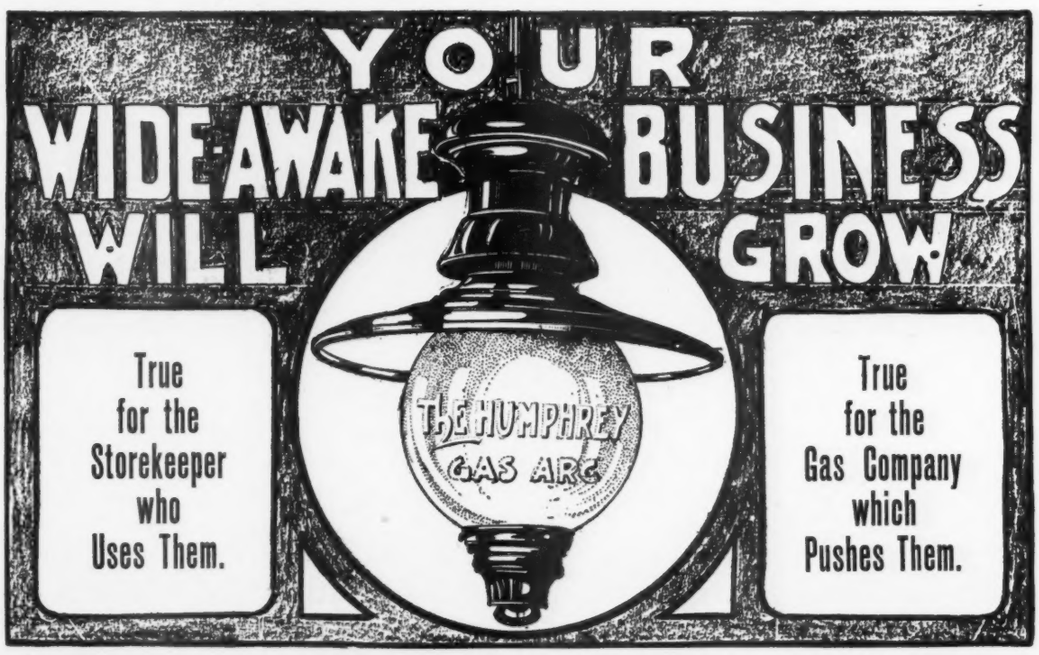
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WILL GROW
True for the Storekeeper who Uses Them.
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Machines Sent to any Gas Company for Thirty Days' Trial.

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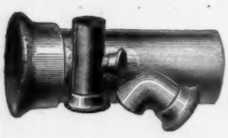

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FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

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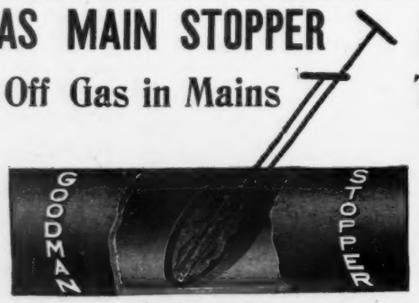
SAFETY GAS MAIN STOPPER COMPANY,

For Shutting Off Gas in Mains

Any size gas main can be shut off in 30 seconds. : : :



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With Instructions for Care and Working of the Same,

By G. LIECKFELD, C.E.
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Do You Wish to Know

what size of pipe to use to convey any quantity of gas, any distance, with any loss of pressure and any initial or final pressure? Then use

Cox's Gas Flow Computer,

as it gives this information accurately at sight, without mental effort. No calculations needed. Saves time, money and mistakes.

Price, 6.5 x 8 inches, in cloth case, $2.50.
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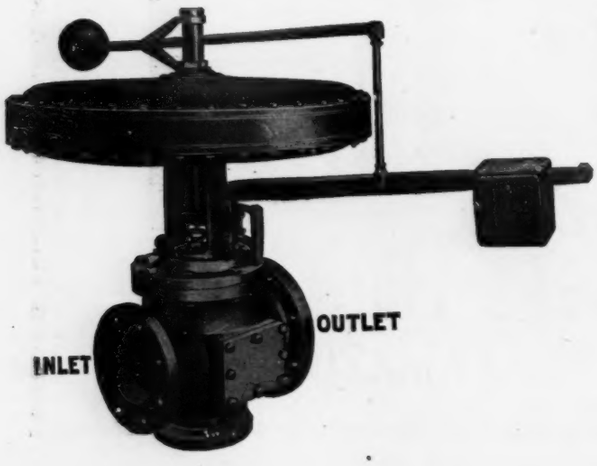

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For District or Service Use.

Our DUPLEX SENSITIVE GOVERNOR, with Automatic Cutoff for district service, will reduce high pressure gas to inches of water without variation.

Absolutely safe and reliable. No complicated mechanism to get out of order. More than 20 years' experience with the largest gas companies.

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AMERICAN METER CO.,

NEW YORK, ST. LOUIS, PHILADELPHIA, SAN FRANCISCO, CHICAGO,

Photometrical and Experimental Apparatus.

PUBLIC LIGHTING TABLE.

APRIL, 1907.

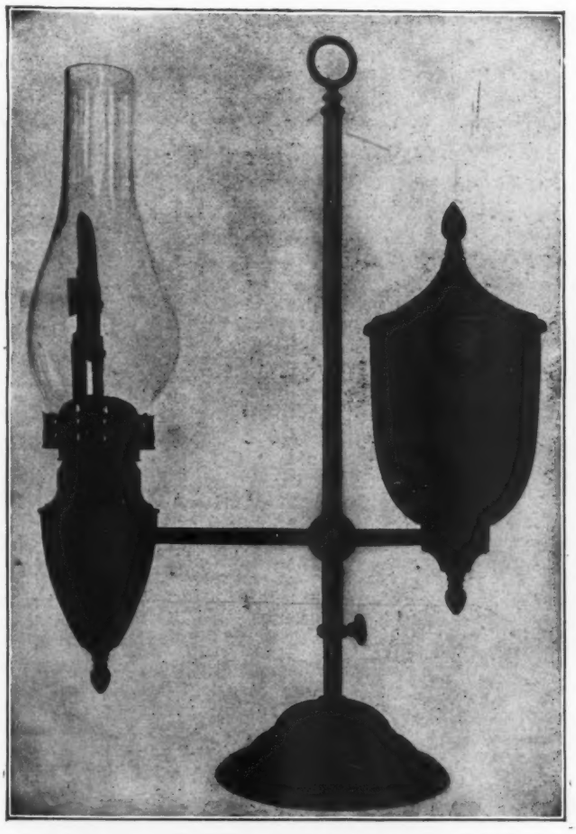
Table No. 1.
FOLLOWING THE MOON.

Day of Week.	Date.	Light.	Extinguish.
Mon.	1	6.50 PM	10.50 PM
Tue.	2	6.50	12.00
Wed.	3	6.50	1.00 AM
Thu.	4	6.50	2.10
Fri.	5	6.50 LQ	3.00
Sat.	6	6.50	3.50
Sun	7	7.00	4.30
Mon.	8	7.00	4.30
Tue.	9	7.00	4.30
Wed.	10	7.00	4.30
Thu.	11	7.00	4.30
Fri.	12	7.00 NM	4.30
Sat.	13	7.00	4.30
Sun.	14	7.10	4.20
Mon.	15	7.10	4.20
Tue.	16	7.10	4.20
Wed.	17	10.20	4.20
Thu.	18	11.20	4.20
Fri.	19	12.00	4.20
Sat.	20	12.50 FM	4.20
Sun.	21	1.20	4.10
Mon.	22	2.00	4.10
Tue.	23	2.30	4.10
Wed.	24	3.00	4.10
Thu.	25	3.30	4.10
Fri.	26	No L.	No L.
Sat.	27	No L FM	No L.
Sun.	28	No L.	No L.
Mon.	29	7.20 PM	9.40 PM
Tue.	30	7.20	10.50

TOTAL HOURS DURING 1907.

By Table No. 1.

	Hrs.Min.
January	211.10
February	193.40
March	182.10
April	167.00
May	157.00
June	145.30
July	151.50
August	162.30
September	175.30
October	202.40
November	209.30
December	231.50
Total, yr.	2190.20



THE ELLIOTT KEROSENE STANDARD PHOTOMETER LAMP.

***

10-Candle Power.

***

This lamp is a perfect substitute for the 10-candle Pentane Lamp hitherto used, and has the following advantages:

1st. It uses Standard Kerosene Oil (Pratt's Astral Oil or equivalent).

2d. It is remarkably steady. Will burn 24 hours continuously with less than 2 per cent. variation.

3d. It is much less dangerous than Pentane, which is a kind of gasolene.

4th. It is not easily affected by air currents in the photometer room.

5th. Since the lamp may burn continuously, the candle power of gas may be taken at any moment, if necessary. This insures steady illuminating power without waste of carburetting material.

6th. The first cost of the lamp brings it within the reach of even small gas works.

7th. Costs much less to maintain than a Pentane lamp or sperm candles doing the same service.

8th. Is not affected by the weather.

PUBLIC LIGHTING TABLE.

APRIL, 1907.

Table No. 2.
NEW YORK CITY.
All Night Lighting.

Day of Week.	Date.	Light	Extinguish.
		P. M.	A.M.
Mon.	1	6.10	4.55
Tue.	2	6.15	4.40
Wed.	3	6.15	4.40
Thu.	4	6.15	4.40
Fri.	5	6.15	4.40
Sat.	6	6.15	4.40
Sun.	7	6.15	4.40
Mon.	8	6.15	4.40
Tue.	9	6.25	4.30
Wed.	10	6.25	4.30
Thu.	11	6.25	4.30
Fri.	12	6.25	4.30
Sat.	13	6.25	4.30
Sun.	14	6.25	4.30
Mon.	15	6.25	4.30
Tue.	16	6.30	4.20
Wed.	17	6.30	4.20
Thu.	18	6.30	4.20
Fri.	19	6.30	4.20
Sat.	20	6.30	4.20
Sun.	21	6.30	4.20
Mon.	22	6.30	4.20
Tue.	23	6.40	4.10
Wed.	24	6.40	4.10
Thu.	25	6.40	4.10
Fri.	26	6.40	4.10
Sat.	27	6.40	4.10
Sun.	28	6.40	4.10
Mon.	29	6.40	4.10
Tue.	30	6.45	4.00

TOTAL HOURS DURING 1907.

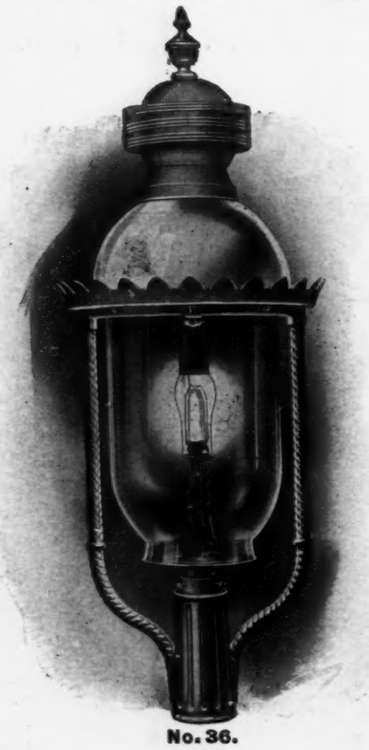
By Table No. 2.

	Hrs.Min.
January	423.20
February	355.25
March	355.35
April	298.50
May	264.50
June	234.25
July	243.45
August	280.25
September	321.15
October	374.30
November	401.40
December	433.45
Total, yr.	3987.45

NEW YORK, 318 West 42d Street.
BOSTON, 820 Beacon Building.
PHILADELPHIA, Broad and Arch Streets.
ST. LOUIS, 712 Roe Building.
CHICAGO, 218 La Salle Street.
SAN FRANCISCO, 512 Oak Street.

WELSBACH STREET LIGHTING COMPANY

....OF AMERICA....



No. 36.

Controls and Operates the **Welsbach System of Street Lighting,**

Which includes its specially DESIGNED and PATENTED BURNER for PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others interested in Municipal and Outside Lighting.

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Succeeds and Excels the Electric Light at One-Quarter the Cost.

THE BURNER.

Elegance of Appearance.
Best Possible Material and Workmanship.
Perfect Combustion.
Lowest Gas Consumption.
Highest Candle Power.
Will Fit Any Fixture.
Will Not Flash Back.
Will Not Blacken Mantles.
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THE MANTLE.

Best Welsbach Quality.
Extra Strong and Durable.
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Rich Mellow Light.

THE GLASSWARE.

Highest Quality Imported.
Special Design Inner Cylinder (No. 317).
Protection from the Falling of Heated Particles.
Increases Candle Power.

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CARBURETTED WATER GAS PLANT IN THE WORLD.

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OF THE

Standard Double-Superheater Lowe Water Gas Apparatus.

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St. Johnsbury, Vt.
Memphis, Tenn. (2d contract).
Council Bluffs, Ia. (2d contract).
Seattle, Wash. (2d contract).
Philadelphia, Pa.
Waterbury, Conn.
Manchester, N. H.
Allentown, Pa.
Omaha, Neb.
Muskegon, Mich.
Nazareth, Pa. (2d contract).
Lewistown, Pa.
Greenville, Tex.
New York, Cent. Un. (3d contract).
Jefferson City, Mo.
Peekskill, N. Y. (2d contract).
Waterville, Me.
Washington, D. C. (4th contract).
Lawrence, Mass. (3d contract).
Hampton, Va.
Aurora, Ills. (2d contract).
Milwaukee, Wis.
Syracuse, N. Y. (2d contract).
Davenport, Ia.
S. Brooklyn, N. Y. (3d contract).
Delray, Mich.
Albert Lea, Minn. (2d contract).
Leominster, Mass. (2d contract).
Clinton, Mass.

TOTAL SETS INSTALLED IN 1906, ... 41
TOTAL SETS TO DATE, ... 634
TOTAL DAILY CAPACITY, ... 502,555,000 cu. ft.

Tar Extractors for Carburetted Water Gas.
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Recording Gauges.
Straight Standpipe System for Coal Gas Retorts.
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HALF AND FULL DEPTH AND FREE FIRING BENCHES,

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"CHRISTY" HIGH GRADE REFRACTORY MATERIAL FOR BENCH SETTINGS, WATER GAS LININGS, ETC.

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GEROULD'S IMPROVED RETORT CEMENT.

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

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In Kegs less than 100 " " 7 " "

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Price, $5. For Sale by
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12-Inch High Pressure Governor.

REYNOLDS' GAS REGULATOR COMPANY,

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We make all sizes for all classes of reduction,

DOUBLE and SINGLE DISTRICT STATIONS,

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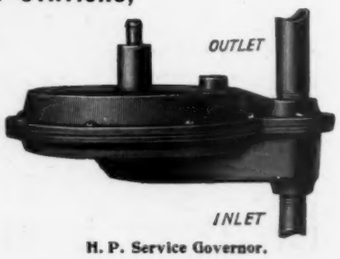
HOLDER GOVERNORS

And Low Pressure Regulators, all of the Dry Diaphragm type.

Write for Catalog.



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COAL CRUSHERS, CONVEYORS AND BINS. TURNTABLES FOR MACHINES.

Labor-Saving Machines for Handling Coal and Coke from Coal Cars to Coke Yard or Bins. Coke Screening and Measuring Plants a Specialty.

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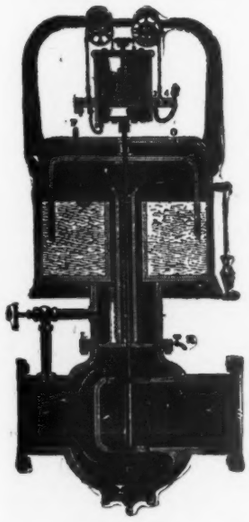

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Roots Improved Gas Exhausters,

Iron Sponge, Purifying Material, for Gas Purification, Jones Jet Photometers, Pressure Registers, etc.,

INSTALLATION OF SMOKELESS TAR BURNING SYSTEM.

Reinforced Concrete Construction for all Purposes,

Wide Experience in High Pressure Installation and Extension.

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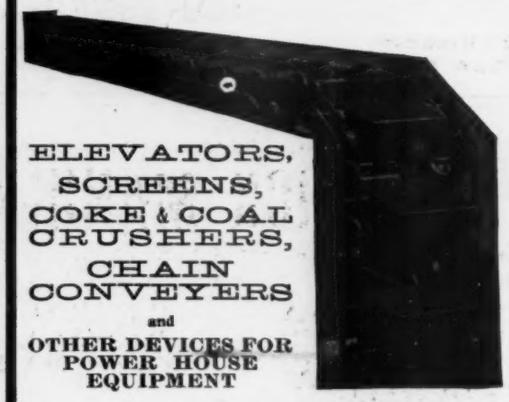

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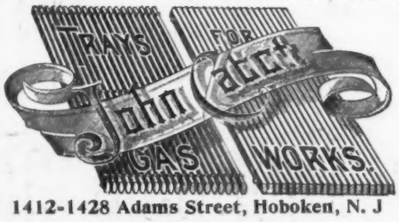

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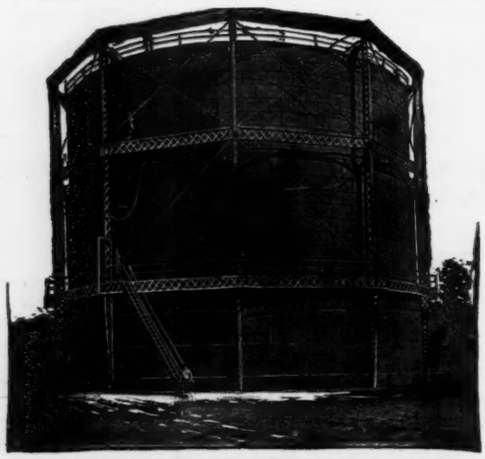

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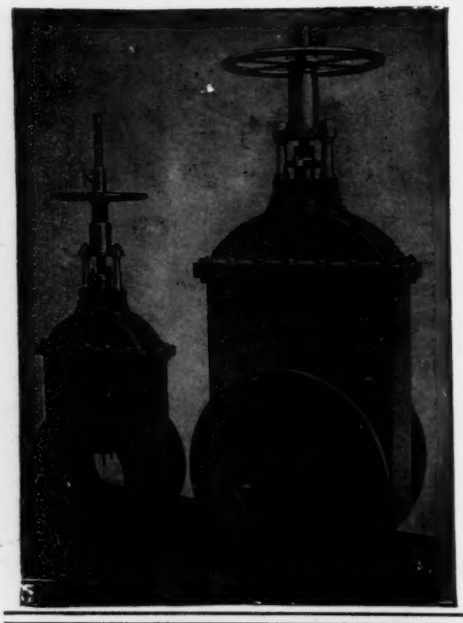

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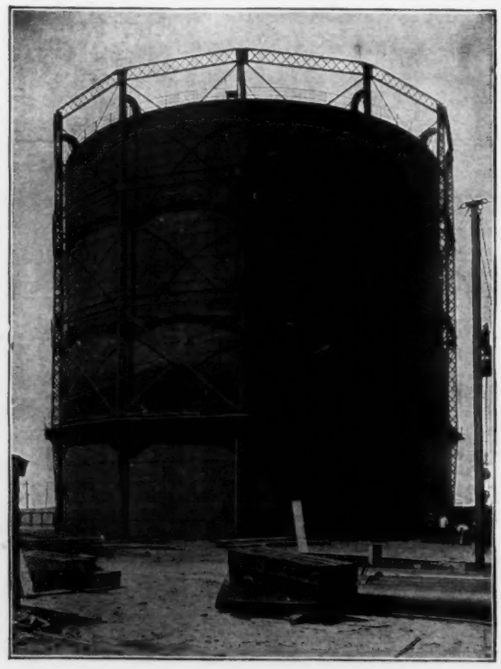

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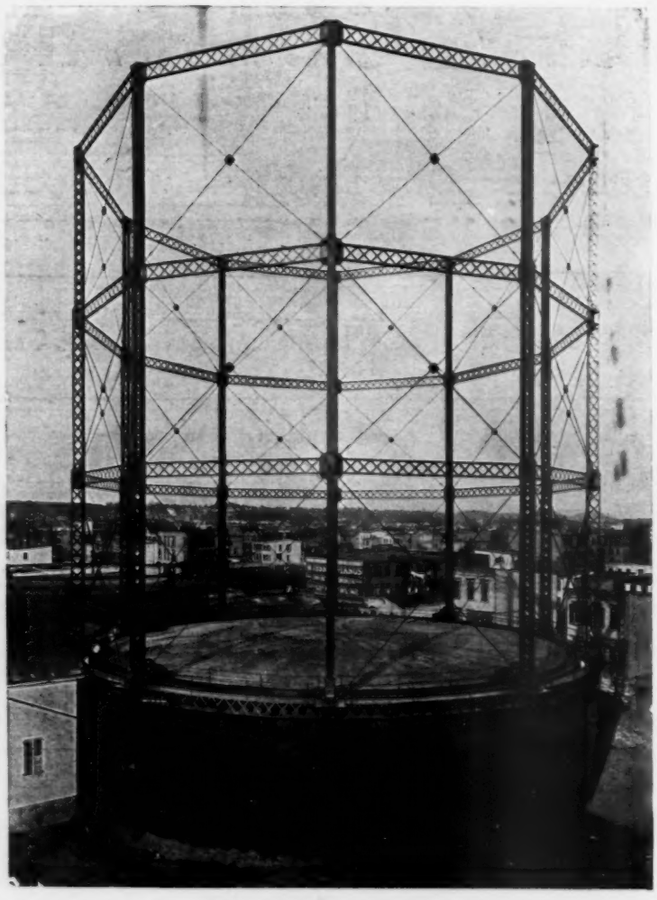

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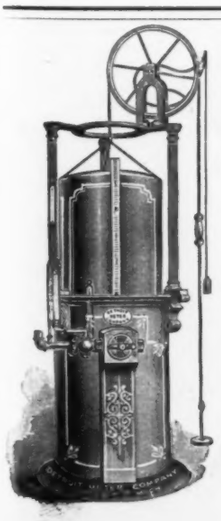

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